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LIGHTING STUDY

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LIGHTING STUDY

SECURITY SYSTEM MODIFICATIONS.

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U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

(11) MAY 1978

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LIGHTING STUDY
SECURITY SYSTEM MODIFICATIONS

INDEX

LIGHTING STUDY
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LIST OF FIGURES AND TABLES

FIGURES

TABLES

REVISION
FEBRUARY 1978

STUDY OF SECURITY LIGHTING SYSTEM AND AUXILIARIES FOR SECURITY SYSTEM MODIFICATIONS AT VARIOUS SAC BASES

1. SCOPE:

The Air Force has been engaged in a program to provide upgraded security at its weapon's storage and aircraft alert facilities. As a part of the program, it was necessary to upgrade the lighting systems in these areas to meet the newer, more stringent requirements contained in AFR 207-1 issued in July 1975 (revised version of AFM 207-1). Lighting surveys of SAC bases in the Continental U. S. and overseas had revealed extensive deficiencies. Because of the large number of facilities and investment in materials involved it was concluded that a detailed lighting study should be made of various lighting schemes to determine the arrangement that would best meet the prescribed illumination requirements both photometrically and economically. The study would examine variables such as type of light source, pole spacing, mounting height, aiming angles, etc. Such a study was conducted by the Corps of Engineers and an initial report issued in December 1975. A set of definitive drawings based on the results of the study was issued in October 1976. They were utilized in the design and construction of upgraded systems at the various weapons storage areas (WSA's) and aircraft alert areas (AAA's or BAA's). The present security approach, however, is somewhat different than that in effect in December 1975. It has evolved through various changes, revisions, and refinements of criteria, security philosophy, and operating format. Current approach is noted in the following discussion.

2. TYPES OF FACILITIES INVOLVED - LIGHTING FORMAT:

There are two different types of areas which are being modified to provide greater security. One area is involved with storage of weapons and materials related to our national defense and the other has as its primary function to provide immediate reaction capability against an attack. The revised lighting is intended to provide an increased deterrent to intrusion sabotage, or hostile action, provide earlier and more reliable detection of such condition, and allow reaction personnel to cope more effectively with a threat.

2-1 Weapons Storage:

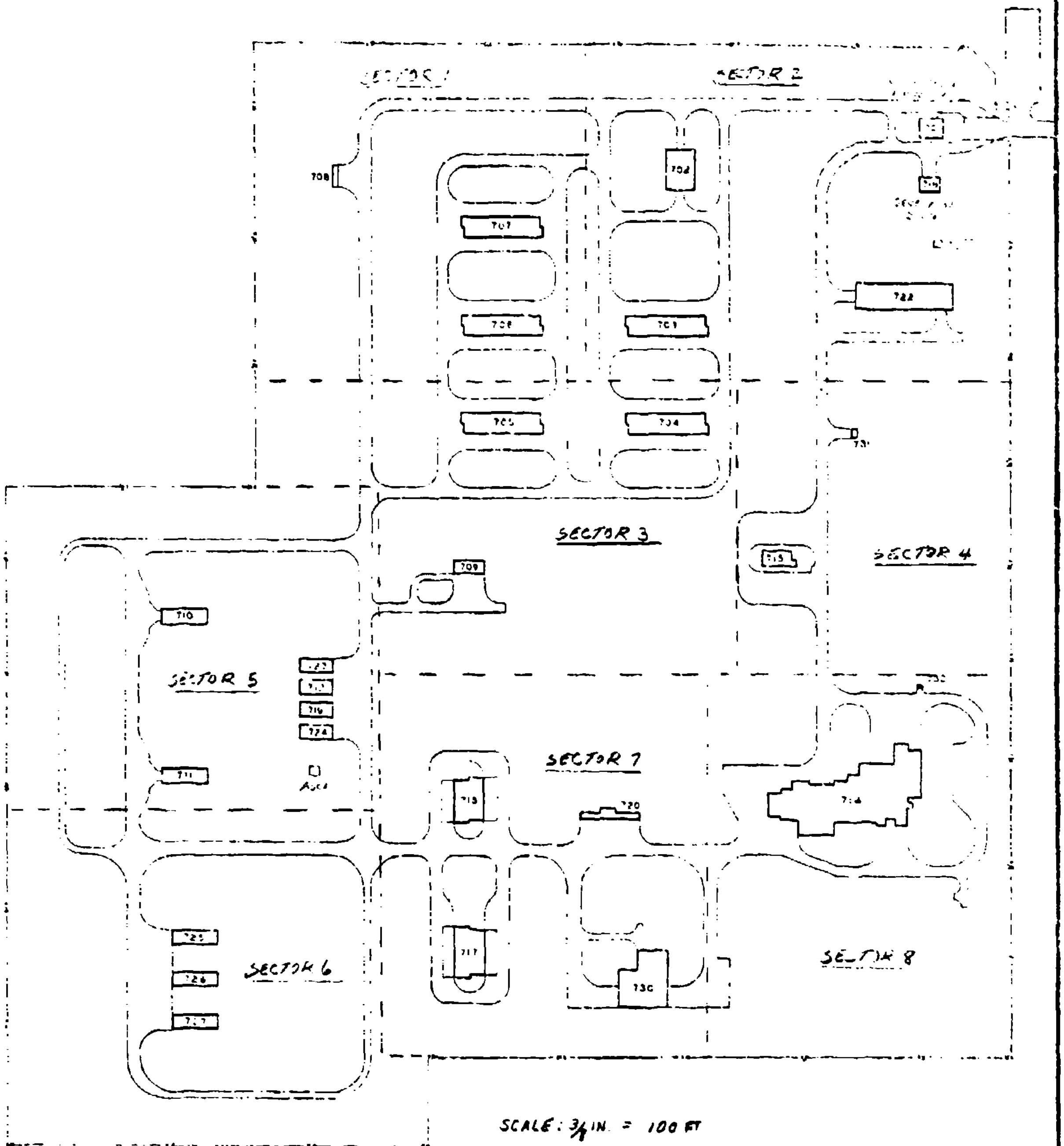
Areas used for weapons storage vary in size depending on the Base. Probably the largest is approximately 3000 feet by 2500 feet; one of the smaller, 300 feet by 1200 feet. A typical area, both in size and operation, is shown on Figure 1. At present most facilities have only a single fence. Future criteria will probably specify a double fence at some areas. Perimeter lighting will be directed outward and is intended to be energized continously during hours of darkness and reduced visibility. It will be switched, in no more than 2 segments, from the Master Surveillance and Control Facility ("MSCF" "Main Control Tower"). Area lighting will normally be off. It will be sectorized with controls at the MSCF. Controls will also be provided at the Entry Control Facility with over-ride capability by MSCF personnel. Guard personnel at the tower will be able to light up a specific location (sector) where there may be an intrusion or other problem. Towers range from 20-50 feet in height.

2-2 Aircraft Alert:

Aircraft alert areas at SAC bases are either of two types: the standard "SAC Christmas Tree" or the mass ramp type. See Figures 2 and 3 for typical layouts. Perimeter lighting will be similar to the format used at the Weapon's Storage Areas with the exception of the taxiway gap. Area lighting will be sectorized; however, for alert areas a center sector will be required with lights installed no closer than a envelope traced by a line 125 feet from hardstand paving. This required width of the center sector will range from 600 to 1200 feet for various bases. Typical will probably be 900 feet for the mass ramp type. For the Christmas Tree type shown in Fig. 3, it would range in width from 475 feet to 750 feet depending on distance selected for lateral spacing of poles.

2-3 Entry Control:

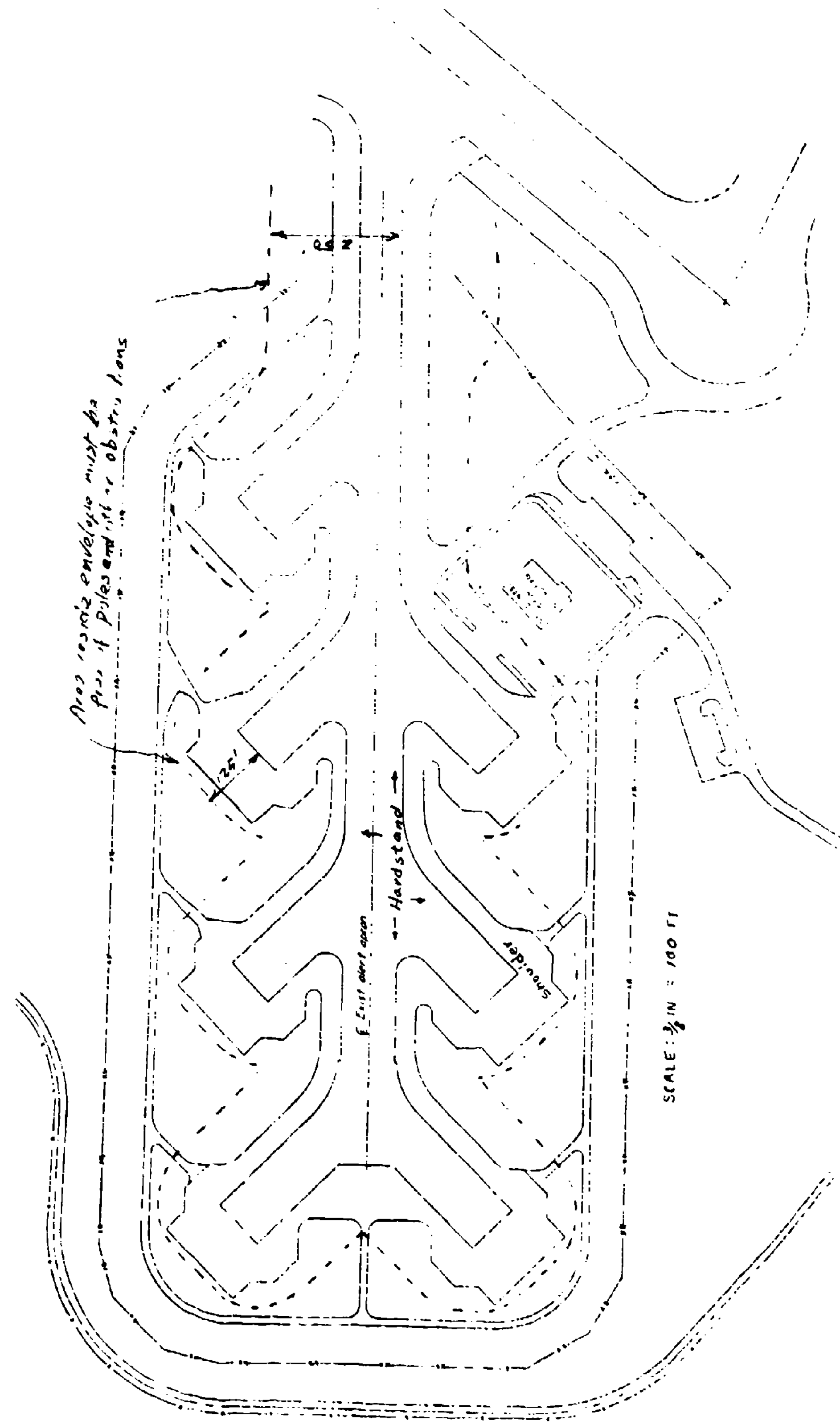
Each of the areas described above has a single entryway through which access is controlled. An entrapment area, enclosed by security fence, straddles the entrapment. Most areas will be subdivided into vehicle and personnel areas. Security police personnel will be stationed within Entry Control Buildings located within or adjacent to the entrapment area.



SCALE: 3/4 IN. = 100 FT

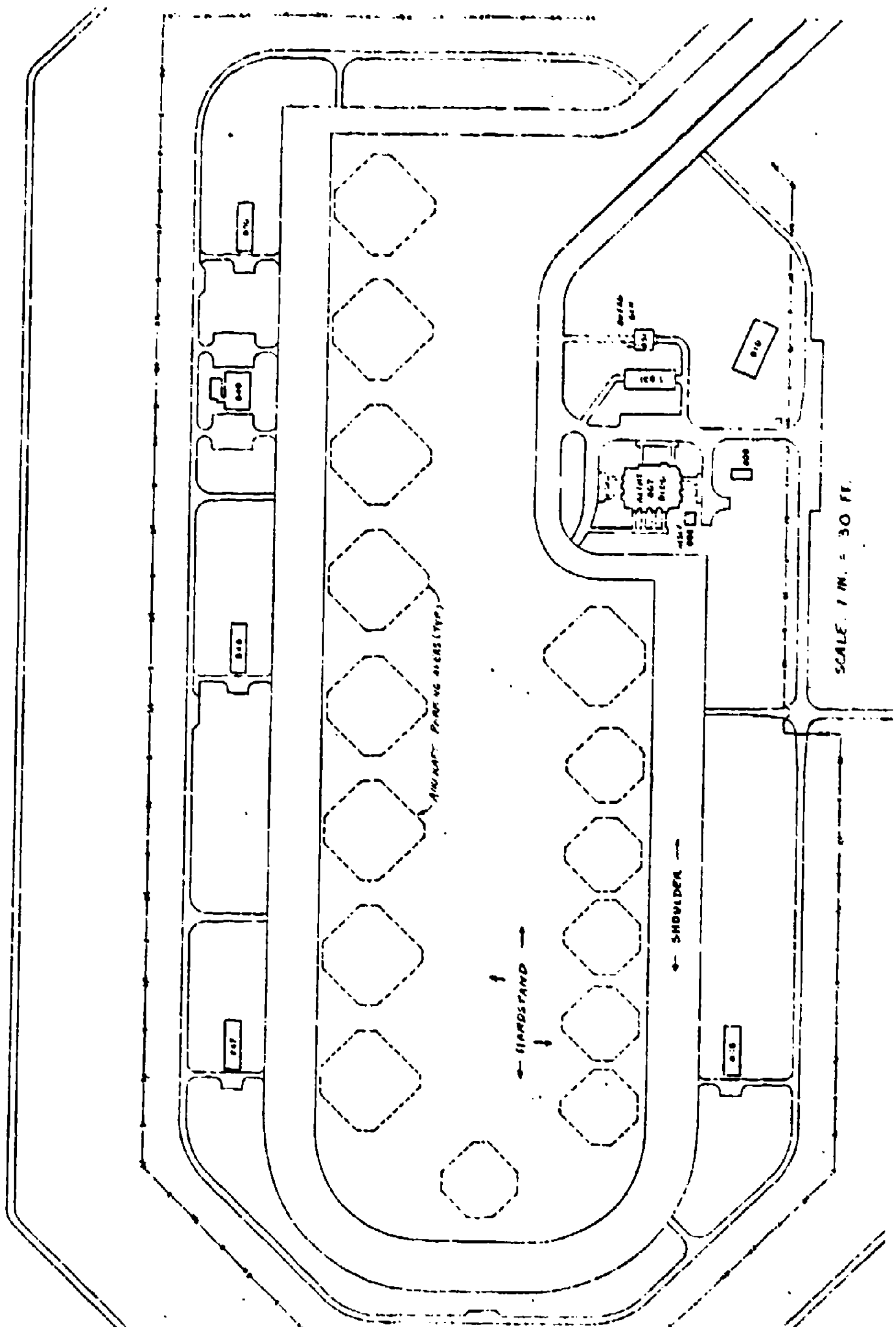
TYPICAL WEAPONS STORAGE AREA

FIGURE 1



TYPICAL AIRCRAFT ALERT AREA - "CHRISTMAS TREE" TYPE

FIGURE 2



SCALE 1 IN. = 30 FT.

TYPICAL AIRCRAFT ALERT AREA – MASS RAMP TYPE

FIGURE 3

3. CRITERIA

3-1 Photometric Requirements:

3-1.1. Perimeter Lighting. For perimeter lighting, a strip from 10 feet inside the inner boundary fence to 30 feet beyond the outer fence must be lighted along the entire length of perimeter fencing. Minimum illumination required by Air Force criteria (AFR 207-1) in July 1975 was 2.0 footcandles, vertical, at the edge of the clear zone, 3 feet above ground and 2.0 footcandles, vertical, at each fence from ground level to 9 feet above above. A maximum of 1.0 footcandle, vertical (photometer perpendicular to the fence) was stipulated for a line, at ground level, 10 feet inside the inner fence. See Figure 4 for illustration. Previous criteria was 2.0 footcandles horizontal, at 6 inches up to 50 feet beyond the fence (derived from DOD 5210.41M (Confidential)). Under present criteria, the strip to be illuminated extends from the inner fence to the outer edge of the clear zone. A level of 2 horizontal (photometer aimed upward) footcandles average, at 6 inches above grade, is required at the time of initial installation. Degradation down to 65% is permissible (1.3 footcandles average, maintained). The uniformity of illumination must not exceed a ratio of 3 to 1. The luminaire is to be centered over the fence to minimize fence shadows.

3-1.2. Area Lighting. For area lighting it will be necessary to provide an arrangement such that there will be a mimimum of 0.4 footcandle of vertical illumination measured at 3 feet above ground throughout the area concerned. A value less than 0.4 footcandle at a particular point in a particular direction will not be considered a violation as long as the 0.4 f.c. measurement can be obtained at some other orientation. See figure 4. In 1975, the minimum value was 0.5 fc. Prior to that the requirement was 0.2 footcandles, horizontal, throughout the area, at the 6 inch level.

3-1.3. Entry Facility Lighting. Present policy stipulates use of a high pressure sodium light source installed in a roadway type of luminaire. A minimum of 2 footcandles of horizontally measured illumination is required within the entrapment area(s) at ground level (6 inches up is acceptable for measurement purposes). A minimum of 1.5 horizontal footcandles is necessary on the 30 foot clear zone in front of the exterior fence. An average level of 0.5 to 1.25 fc is desired for background lighting. The ECF lighting zone extends 25 feet from the ends of the gateway(s) and 25 feet behind the ECF building. The background lighting requirement applies to the exterior area(s) lying to the sides and behind the entrapment area.

3-1.4. Taxiway Gap Lighting. The minimum size taxiway gap will have dimensions of 425 ft across the taxiway by 60 ft. deep. The lighting zone will extend 15 feet farther (to a 75 ft depth) on the taxiway itself. The minimum acceptable illumination in the defined lighting zone is 1.5 vertical footcandles, obtained at any orientation from 0° to 360° horizontally in a plane 3 ft above ground.

3-2 Special Requirements and Limiting Factors.

The selection of a light source and specific layout arrangement was governed by certain special considerations. The impact of some of these factors will be analyzed elsewhere in this report. The following are some of the significant items:

3-2.1. Instant-On Fixtures. The area lighting will normally remain off (see Section 2). When circumstances call for one of the sectors to be lighted, it will be necessary that full illumination be provided almost immediately. For the subject facilities full illumination within five (5) seconds has been stipulated. The practical effect of this requirement is to eliminate all but the quartz iodine type of light source.

3-2.2. Instant Restrike. Perimeter lighting for both types of areas must provide continuous illumination at 100% of criteria levels during hours of darkness (see above). Unless UPS (Uninterruptible Power System) equipment is provided (or the requirement modified somewhat), this will require use of the quartz iodine lamp either entirely or to provide backup illumination during the restart interval of other lamp types.

3-2.3. Mounting Height. For perimeter lighting, Air Force policy in 1975 was that luminaire mounting not exceed 15 feet in height. Current policy allows 25 feet for single fence layouts and 35 feet maximum for double fence sites.

3-2.4. Clearance from Perimeter Fence. Lighting poles had to be set back at least 15 feet inside the inner fence under 1975 criteria. At present poles are to be placed approximately 3 feet back at WSA's, 6 feet at AAA's.

3-2.5. Airfield Clearances. Area lighting must be installed outside an area defined by an envelope of 125 feet from the limits of the hardstand paving per AFM 86-8. A clearance of 250 feet is required at taxiway areas (measured from far side of taxiway). In addition a 2000 foot approach zone is required along runways (1000 feet on both sides of the centerline). From the limit of that zone a 1 on 7 gradient is required. For more information, refer to the clearance layouts on Definitive Drawing AD 86-11-01, Sheets C-1 and C-4. No lighting or power poles can be higher than that envelope. These factors will limit pole location and heights at some facilities. The effect of jet blast is also to be considered relative to pole location.

3-2.6. Reliability. The type and arrangement of the lighting system has to be such that failure of one unit will not affect the rest of the system. The equipment must operate as intended irrespective of seasonal temperature variation and weather conditions.

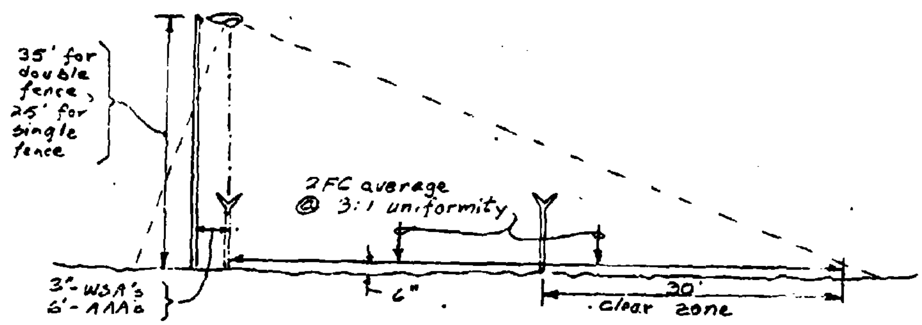
3-2.7. Hardening. Components which are essential to the functioning of security lighting (or other essential services) and which might be vulnerable to sabotage, must be hardened to prevent the breakdown of an entire system. Hardening is not required for components

mounted 15 feet or more above the ground. Generators will normally be housed in hardened concrete structures. Electrical distribution within 200 feet of the perimeter fencing should be underground. Pad-mounted transformers and lighting controls should be contained within hardened enclosures.

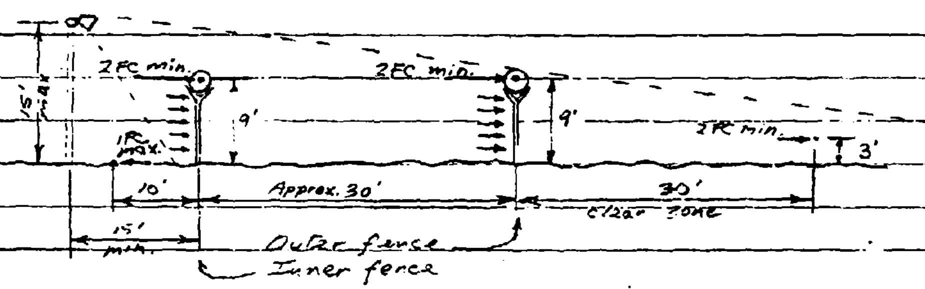
3-2.8. Backup Power. An alternate power source is necessary to replace commercial power during conventional outages or intentional sabotage to insure continuous operation of lighting and other security facilities. Automatic switching to full load capability on the line within 60 seconds maximum must be provided.

3-2.9. Sectorizing. As mentioned previously area lighting has to be divided into several individually controlled sectors. Each sector has to stand alone relative to establishing the basic format (number of luminaires per pole, horizontal aiming, pole spacing, distance between rows). However in placing the border of the sector, the illumination contribution from an adjacent sector can be included. This is acceptable on the basis that should the center of attention (intruder, etc.) shift to the edge of the sector, the adjacent sector lighting will be turned on.

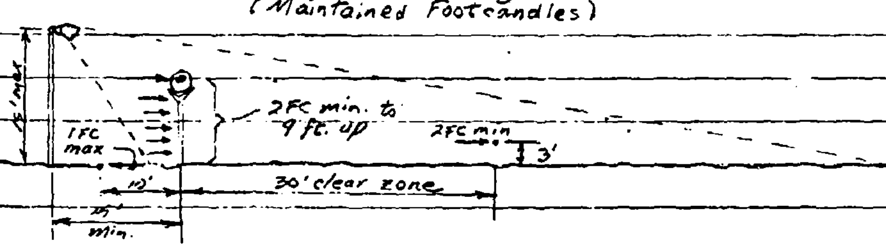
3-2.10. Visibility/Glare. The traditional approach for perimeter lighting has been to project glare toward an intruder approaching the secured area, while leaving reaction forces within in relative darkness. Initial designs in 1975 and 1976 followed this approach using high pressure floodlights. The present format, however, requires uniform illumination that will provide maximum visibility for viewing by TV surveillance systems (TV cameras typically will be aimed down the fenceline). A meeting at Eglin Air Force Base on 20-22 February 1977 established the roadway luminaire as the standard for perimeter lighting.



PERIMETER LIGHTING REQUIREMENTS - 1977
(Initial Footcandles)

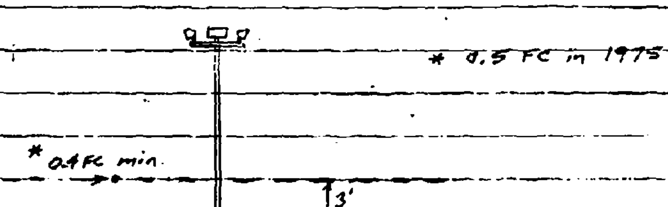


a. Double Fence Configuration
(Maintained Footcandles)



b. Single Fence Configuration
(Maintained footcandles)

PERIMETER LIGHTING REQUIREMENTS - 1975



Note: A reading of 0.4* footcandle on a photometer oriented in any direction from 0° to 360° in a horizontal plane 3 ft. above the ground will be considered to have fulfilled the criteria.

AREA LIGHTING REQUIRSMENT
(Maintained footcandles)

FIGURE 4

4. BACKGROUND FOR THE STUDY:

4-1 General: The prescribed objective of the lighting study was that the most efficient arrangement both photometrically and economically be determined. The study was to proceed, initially, in an unconstrained mode, on the basis that all arrangements that might feasibly fulfill the objectives of the study be considered. The effect of varying such parameters as mounting height, luminaire orientation, aiming angle, quantity of luminaires, pole spacing, etc., were to be considered. The effects of constraints such as 15 foot mounting height limitation (perimeter lighting), clearances from taxiways or hardstands, instant start or restrike requirements, maximum of 1 footcandle spill light 10 feet inside perimeter fence, etc. were also to be considered. The economic penalty, if any, resulting from such constraint was to be identified.

4-2 Lighting Schemes Considered: To provide the illumination levels described in Section 3, a number of different schemes, as listed below, were evaluated. The low pressure sodium source was not one of the specified schemes in the original criteria, but was included here, with Air Force concurrence, since available literature indicated it was a lamp of very high efficiency.

4-2.1. Area Lighting:

a. Quartz Iodine Fixtures. Because of the instant start requirement and the relatively infrequent use (unlikely to total over 200 burning-hours over an entire year), there would be little gain in considering other types of lamps.

4-2.2. Perimeter Lighting:

a. Quartz Iodine Fixtures.

b. High Pressure Sodium (HPS) fixtures with supplemental means of insuring 100% illumination during restart interval (Provided by quartz fixtures serving as backup illumination until the H.P.S. can build up to full illumination output. Quartz units would automatically shut off at that point.)

c. H.P.S. with 75% backup illumination during the restrike interval.

d. H.P.S. with 50% backup illumination during the restrike interval.

e. H.P.S. plus an Uninterruptible Power System. The U.P.S. had to be of sufficient capacity to maintain service without a break to the H.P.S. lights for 15 minutes.

f. H.P.S. with spill light from Area lighting fixtures being utilized to provide backup illumination during the restrike interval.

g. Low Pressure Sodium (L.P.S.) fixtures with supplemental means (quartz iodine lamps) of providing 100% illumination during the interval required to return to full brillance.

h. L.P.S. with 75% backup illumination during the interval required to return to full brilliance.

i. L.P.S. with 50% backup illumination during the interval required for full brilliance to be restored.

j. L.P.S. plus U.P.S. of sufficient capacity to maintain uninterrupted service to the lights for 15 minutes.

k. L.P.S. with Area Lighting being switched on (by personnel at MSCF) to provide spill light as backup illumination while the UPS builds up again to rated light output

4-3 Light Sources Considered - Description:

4-3.1. General. The primary purpose of a light source is generation of light energy. The efficiency at which this end is achieved is expressed in lumens output per watts consumed (input). The maximum theoretical efficiency (luminous efficacy) of an ideal white source (one which radiates a constant output over the entire visible spectrum and none outside that spectrum) is 220 lumens per watt. If the input energy were to be radiated only as a monochromatic yellow green, at a wavelength of 5550 angstroms (the region of the spectrum most sensitive to the eye), the theoretical efficacy would be approximately 680 lumens per watt. The first electric lamps in the 1880s produced 2 lumens per watt. The modern low pressure sodium lamp achieves approximately 180 lumens per watt, the greatest achieved thus far in a commercially available lamp.

4-3.2. Incandescent Lamp. The incandescent lamp is the oldest lamp type presently in use. A tungsten filament serves as the light source although not very efficiently since only 10% of its output is usable light, the rest being primarily heat. The lumen efficiency can be increased slightly but at the cost of shorter life. The quartz iodine (tungsten halogen, tungsten halide) variation contains a halogen gas which tends to regenerate the tungsten thus increasing life. Quartz lamps find their greatest application for flood lighting where low initial cost and/or instant start requirements govern. A summary of this lamp's significant characteristics and a comparison with other sources is contained in Figure 5. A quartz lamp has negligible lumen depreciation over its operating life. The lamp is limited to operation in the horizontal position. See Figure 16.

4-3.3. Fluorescent Lamp. In fluorescent lamps, a ballast causes an arc to strike between cathodes. The arc causes mercury vapors under low pressure to emit ultraviolet radiation which causes fluorescent powders to generate visible light. These lamps have relatively long

life and low surface brightness (glare) with application for interior lighting primarily. Their poor beam control and instability during temperature changes limits their usefulness outdoors.

4-3.4. High Intensity Discharge (HID) Lamps. These lamps have a gaseous arc and operate under pressures and current densities sufficient to generate visible light from their arcs alone without additional additives. Like most discharge arc lamps, they have a negative resistance characteristic which requires a ballast to limit current to the lamp and supply the proper starting voltage. Mercury lamps have a quartz arc tube containing mercury for light generation, argon for starting, and in some lamps added phosphors for color improvement. Metal halide lamps contain iodide additives for better color rendition and greater light output. Both of these lamps suffer from comparatively long restart intervals. High pressure sodium lamps contain a ceramic arc tube with xenon gas added for starting. They have the advantage of a significantly higher lumen output and a relatively shorter restrike time. A characteristic common to HID lamps is the necessity for lamps to cool down and the pressure to drop before restrike can occur. This process must occur whenever the arc has been lost. A break in power as short as one cycle (16.67 milliseconds) or a sudden dip in line voltage (as small as 25% for HPS) can extinguish the arc. The cool down interval ranges from 20 minutes for metal halide lamps to 1-2 minutes for high pressure sodium depending on the manufacturer and the lamp size. The low pressure sodium lamp shares the negative resistance characteristic of HID lamps, however it performs somewhat differently because it operates at significantly lower vapor pressures. See subsection 4-3.6. for more details.

4-3.5. High Pressure Sodium (HPS) Lamp. HPS lamps were pioneered in the U.S by the General Electric Company in the mid 1960's and have found rapidly increasing acceptance as a result of the increased emphasis on energy conservation. Efficacy of the bare lamp alone extends to 130 lumens per watt in the larger sizes. Over 25% of its output energy is in the form of usable light. HPS lamps utilize a different ballast design than mercury or metal halide because of the high voltage high frequency starting pulse required. Warm-up time is approximately 5 minutes to full output. Operating pressure is lower than for a mercury vapor or metal halide lamp which, coupled with the different starting method, allows restrike times to be lower - approximately 1-2 minutes, 3 minutes maximum. HPS lamps have a characteristic golden-yellow output (yellow, orange, and red predominate). The lamps themselves are physically quite compact compared to other types of lamps and allow luminaire designs having excellent beam control. Lamps made by General Electric are limited to a vertical mounting position, either base up or base down. The vertical aiming can be adjusted up to approximately 90° from the design position; if aiming extends beyond that, part or all of the sodium amalgam may spill from its reservoir. The newest Westinghouse and Sylvania lamps can be operated in any position with apparently minimal effect on lamp life. In a HPS lamp operating voltage increases over its rated life. The extent of rise determines lamp life. When the required input voltage to the lamp exceeds the voltage supplied by the

ballast, the lamp will cycle on and off. At this point the lamp must be replaced. Extended operation in this mode (a maximum of 50 hours has been recommended) or operation without a lamp will cause damage to the ballast.

4-3.6. Low Pressure Sodium (LPS) Lamp.

a. History. The first practical LPS lamp was introduced commercially in this country in 1932. Efficacy then was 50 lumens per watt. Development effort here, however, on a lamp for outdoor use, soon faded and effort was concentrated instead on the mercury vapor source, plus, variations of the incandescent, and later others such as metal halide and HPS. On the other hand, in Europe the lamp came into wide use for applications such as roadway lighting. It has recently reentered the commercial lighting market in the United States. A partial listing of locations where LPS equipment has been installed and organizations that have studied LPS lighting is included in Attachment 8. Other articles and information on LPS is included in Attachments 5, 9, 10 11 and 12.

b. Description of Lamp Types. There are two types of lamps available: one manufactured by General Electric Company Ltd. (G.E.C.) of England (not affiliated with General Electric Company of the United States), the other made by N.V. Phillips Company of Eindhoven, the Netherlands. (Norelco is the primary outlet for Phillips Products in the U.S.). Presumably an essential difference between the two lamps is that the G.E.C. lamp is a constant wattage type with lumen output decreasing over life, the other a constant lumen type with the lamp absorbing a gradually increasing amount of input wattage over its rated life. On this basis, an engineering decision should involve evaluating the trade-off between lower light output or additional energy consumption. However, it has not been possible to verify that the difference is as significant as proponents of the G.E.C. lamp have indicated. In practice it appears that the lamp will experience some wattage increase although less than the Norelco lamp. The Norelco lamp apparently undergoes a slight increase in lumen output over its rated life.

c. Lamp Construction and Operation. Lamps are of the arc discharge type. The arc tube is constructed of borate glass (to resist attack by sodium) backed by lime glass (to seal out moisture). It contains sodium under a very low vapor pressure plus one or more starting gases such as neon, argon or xenon. As is characteristic of arc-discharge lamps, light output is dependent upon arc-temperature and vapor pressure. Ionization of the starting gases increases temperature in the tube causing the sodium to vaporize (at 90°C). Tube within a tube construction with a vacuum between insures excellent thermal insulation properties. Ambient temperatures between -10°C to 40°C have no practical effect on light output or starting. There are two different varieties of arc tubes - dimpled vs smooth construction. Dimpled lamps utilize indentations spaced along the tube serving as reservoirs of sodium to counterbalance the sodium migration characteristic which occurs toward the end of useful lamp life. Norelco lamps use this approach. G.E. of England utilizes a smooth tube with a heat reflecting film on the lamp jacket. Film thickness is tapered along the length of

the lamp to balance thermal and electrical gradients in the arc tube and thus maintain sodium vapor light output constant over rated lamp life. According to the ballast manufacturer, the two lamps should be completely interchangeable in any fixture without any adverse affect on either ballast or the lamp. See attachments 1 and 2 for literature on the lamps.

d. Starting and Restrike. Once the arc has been ignited, heat from the starting gas discharge begins to vaporize the sodium. The vaporization process continues for 7 to 15 minutes, depending on the particular lamp, until full light output is achieved. Restrike is almost immediate since the temperature and pressure have to drop only slightly to enable restrike to occur. The lower wattage lamps exhibit better characteristics than the larger units. A sample 35 watt luminaire from Quality Outdoor Lighting (G.E. of England lamp) tested in this office in September 1975 provided immediate (within 3 seconds) restrike and full illumination for power breaks up to 2 minutes duration. Total warmup time from cold start was 8 minutes. "Off" intervals from 2-4 minutes duration had fairly sharp dropoffs of illumination, which then leveled off until at a 15-minute interval conditions were equivalent to cold start. Tests made by Southern Division, Naval Facilities Engineering Command in September 1975 using 4-90W Verd-A-Ray fixtures showed average restrike times of approximately 2 minutes for a 30 second break in power. Representatives from North American Phillips and SEPCO Lighting have indicated immediate restrike for outages of up to 5 minutes duration. See Attachments 3 and 4. Test data on new 180 W lamps was received from the Los Angeles representative of Norelco in March 1977. After a power break of 1 second duration, 65% of the lamps reignited immediately, 85% within 2 minutes. Lumen output was 67% initially increasing to 87% of normal at 2 minutes. If the power interruption was a full minute in duration, 73% of the lamps reignited immediately, 100% at 1-3/4 minutes. Lumen output was 73% initially 102% at 2 minutes, settling down to normal (100%) after 5 minutes.

e. Color Rendition. Light from low pressure sodium lamps has a reddish coloration initially due to ionization of the neon starting gas. This changes to a monochromatic yellow at full output. This area of the visible spectrum is most sensitive to the human eye, which results in maximum efficiency in energy usage to achieve a given level of useful illumination. Objects viewed under this light will tend to lose their color quality; discrimination between red and orange, blue and green, etc. will be difficult other than as degrees of brightness or darkness. However, according to representatives of Quality Outdoor Lighting, addition of supplemental light from another wider spectrum source of one-fifteenth or more of the LPS illumination level will restore color quality. For roadway lighting, public acceptance after an initial adjustment period has apparently been relatively high. See Attachments 6 and 10 for results of opinion surveys.

f. Special Considerations. To maintain optimum light output and lamp life requires that the higher wattage (135,180W) luminaires

be mounted with the longitudinal axis not more than 20° from the horizontal. This assures more uniform operating temperature along the tube and minimizes concentration of sodium at one end.

g. Availability. Low pressure sodium lighting has only recently been reintroduced into this country and as yet is still relatively unknown. However, interest in this source is growing. Luminaires and ballasts are manufactured in the United States. Lamp stocks are maintained here, but lamps at present are still manufactured overseas. See Attachment 7 for addresses. Either type of LPS lamp can be operated in a given fixture; there may be some difference in lumen output or wattage drawn in a particular application, however.

4-3.7. Xenon. Two types of lamps are available, short arc ("compact arc") and long arc. The short arc lamp has found more commercial application than the long arc. These include use for search lights, projection lamps, studio lighting, optical instruments and display systems. The main application for the newer long arc lamp has been for sports lighting or similar configurations where poles have to be placed outside the area to be lighted. Short arc lamp enclosures operate under high internal pressures (10-50 atmospheres), whereas long arc lamps are subject to much lower (and safer) pressures of 1 atmosphere maximum. Short arc lamps utilize resistive or inductive ballasts; long arc lamps require only a starter. Starting voltage pulses are under 600V (line voltage) for the long arc unit vs. several thousand volts for short arc. Both lamps reproduce the spectral energy distribution of natural light with exceptional fidelty, better than any other artificial light source. Starting and restrike is essentially instantaneous (2 seconds). The long arc fixture is available without the instant start feature, restrike is 30-60 seconds. Efficacy of the long arc lamp is 20-27 lumens per watt. Short arc lamp efficacies range from 20 to over 50 lpw. The long arc fixture has the disadvantage of being heavy and bulky (265 lbs, 84 inches long for 20 kw unit). In the U.S. sources of long arc luminaires and lamps are limited to American Daylight Co. International of Phoenix, Arizona and EC & G Inc. of Salem, Massachusetts (lamps only). The short arc lamps and fixtures are more competitive with a variety of sources available.

4-4 Evaluation of Lamp Sources.

4-4.1. General. Each of the various lamp types has its own characteristic features which may be advantageous or disadvantageous, depending on the application. Comparative characteristics are shown in Figure 5. Table I contains a listing of lamp sizes and the nearest equivalent, based on relative lumens per watt, for other types. Specific factors which determined the selection of lamps for this application are discussed in the following paragraphs.

4-4.2. Cost. The incandescent units have the lowest initial cost, but are relatively high in energy consumption. The HPS and LPS conversely, have relatively high initial cost and very low operating cost. The highest initial cost ($2500 for a 20000 watt fixture) occurs with long arc xenon units.

4-4.3. Efficacy. The incandescent sources have the lowest lumen output at 12-23 lumens per watt. The highest efficacies are available from the the LPS sources, 183 lpw for the 180 lamp alone, 135-140 lumens per input watts to the luminaire The HPS source is next best at 140 lpw for the bare lamp, and 90-95 lpw for the lamp/luminaire assembly.

4-4.4. Lamp Characteristics. Comparative data on lamp mortality and lumen depreciation over life is shown in Figure 7 (also refer to Figure 8 and Attachment 4). It should be noted that lamp characteristics have been upgraded since this chart was compiled and that some lamps have slightly longer operating life or better mortality than indicated. For the purposes of this lighting study, it was assumed that group relamping would occur when 20% of the total lamps initially installed had been spot replaced (80% survival). Maintenance factors (dirt factor X lamp lumen depreciation) were determined, from manufacturers data, using the LLD corresponding to this point on the mortality curves. See table III for typical maintenance factors. The HPS lamp suffers a decline in lumen output over life which results in a change in efficacy from approximately 105 lpw initial to an average of 92 lpw. The LPS lamp has ballasts which are designed to compensate for the lumen degradation by increasing the wattage delivered to the lamp. The Phillips lamp will even show an increase in its lumen output. Power consumption by this lamp rises from 180 watts initial to approximately 240 watts at end of life. Change in efficacy drops from 150 lumens per watt (lpw) initial to an average of 136 lpw. Although firm data has been difficult to obtain, indications are that the G.E.C. lamp also has an increased energy consumption over its life, although of lesser degree, plus some decrease in lumen output. See Table II. In computer analysis, we have used figures of 40 watts and 10 watts respectively for the wattage rises projected at 20% mortality for the Phillips and G.E.C. lamps.

TABLE I - EQUIVALENT LAMP SIZES BY WATTAGE* (APPROX.)

Quartz or Incandescent	Fluorescent	Mercury Vapor	Metal Halide	High Pressure Sodium	Low Pressure Sodium
200	55/60	100	--	50	35
250	2x40	175	--	70	55
500	4x40	250	175	100	90
750	--	250/400	175	150	135
1,000	--	400	250	150/250	135
1,500	--	--	400	--	180
--	--	700	--	400	--
--	--	1,000	--	--	--
--	--	--	1,000	--	--
--	--	--	1,500	1,000	--

*The lamp sizes listed are based on the wattages of lamps alone, actual input wattage to fixtures may be higher than these nominal sizes due to ballast losses. Equivalency is determined from rated lumen output.

TABLE II - COMPARISON* OF HIGH PRESSURE AND LOW PRESSURE SODIUM FIXTURE CHARACTERISTICS OVER RATED LIFE

	LPS		HPS
	GEC	PHILLIPS	
Initial Lamp Wattage	180	180	395
Lamp Wattage at end of life	200	240	400
Ballast Loss (watts)	40	40	80
Total Input Watts - Initial	220	220	475
Total Input Watts - Final	240	280	480
Initial Lumens	33,000	33,000	50,000
End of Life Lumens	28,050	34,000	37,500
Efficacy Initial (Lum/W)	150	150	105
Efficacy - Final	117	121	78
Efficacy - Average	134	136	92

*These figures are based on available information. Operating experience on these lamps apparently has not been sufficient to publish firm detailed data, particularly for the GEC lamp. The figures represent averaged performance; individual lamps off the production line may perform somewhat better or worse than indicated.

TABLE III - MAINTENANCE FACTORS

TYPE OF LAMP	NECA* MF	RATED LIFE (50% Fail)	RELAMP (20% Fail	CORPS OF ENGINEERS		
				LLD	DF	MF
Incandescent	0.75					
Quartz	0.85	2000	1600	0.95	0.85	0.81
Mercury Vapor (White)						
175-700W	0.70					
1000W	0.65					
M.V. (clear/color impr)						
175-700 W	0.75					
1000W	0.70					
Metal Halide	0.65					
High pressure Sodium	0.75					
250W Floodlight	---	15000	9500	0.85	0.85	0.72
250W Roadway	---	15000	9500	0.85	0.80	0.68
400W Roadway	---	20000	13000	0.85	0.80	0.68
Low Pressure Sodium						
180W Phillips	---	18000	14000	1.00	0.90	0.90
180W G.E.C.	---	18000	14000	0.85	0.95	0.81

*NECA data is taken from their "Electrical Design Guidelines" series.

4-4.5. Lumen Output vs Voltage Drop. For fluorescent and HID lamps lumen output is influenced primarily by ballast design. Ballasts are readily available which will limit changes in lumen output (or wattage) to ± 3% (or ± 5% some mfrs.) under a line voltage fluctuation of ± 10%. Standard incandescent and tungsten halide lamps, however, are very sensitive to line voltage variations from design operating voltage. A lamp operated at 5% below design voltage will deliver only 85% of the rated lumen output. Allowance for voltage drops in supply circuits will have to be made. See Figure 8. (Example: An area designed to a level of 0.47 footcandles minimum will yield 0.4 FC minimum if the actual voltage delivered to the lamp due to voltage drop in the line is 95% of rated lamp voltage.)

4-4.6. Color. Of the artificial light sources, the xenon lamps most nearly duplicate the color spectrum of sunlight. The output of incandescent lamps spans the entire light spectrum but tends to be strong at the red end. Fluorescent lamp output is spotty, tending toward the violet end of the spectrum, special natural spectrum lamps are available however. The HID sources also have irregular spectral distributions. The metal halide lamps generate a set of color components that most closely, of the HID sources, resembles natural light. The light energy from HPS sources is predominately yellow and yellow-orange plus some low intensity components of red and blue. The LPS lamps concentrate virtually all of their light energy in a monochromatic yellow component.

4-4.7. Visibility/Glare. Glare as perceived by an observer can be of two types, discomfort glare or disability glare ("veiling glare", "blinding glare"). If disability glare is present, the observer's visual performance will suffer. Discomfort glare will make an individual uncomfortable but will not necessarily interfere with visual perception or discrimination. Most of the factors having an influence on glare, such as reflector design, type and construction of lense or refractor, orientation or location of luminaires, are not inherent in the lamp itself. However compact, high output sources such as HPS will create some direct glare problems because of the relative brightness per unit area. Physically large lamps such as LPS or fluorescent appear less intense to the observer even for units equivalent in lumen output to the HPS. The luminance (photometric brightness) of a LPS lamp is approximately 65 candela (cd) per square inch, 2900 cd/sq. in for mercury vapor lamps, and 6500 cd/sq. in. for HPS (to obtain values in footlamberts multiply by 452). Some users are of the opinion that LPS permits more discrimination of objects than HPS; others report particularly good light penetration on heavy fog.

4-4.8. Warm-Up/Restrike. One of the greatest advantages of quartz iodine and other incandescent lamps is that they produce full illumination almost instantaneously when energized. Xenon and fluorescent lamps for most purposes, can also be considered to have instant start/restrike characteristics. Xenon's high cost and fluorescent's mediocre photometric

performance outdoors outweigh these advantages for most applications. The HID lamps such as mercury vapor and metal halide have relatively long restrike intervals of approximately 5 and 15 minutes respectively. Manufacturers of high pressure sodium utilize a high voltage starting pulse to cut this interval to approximately 1-1/2 minutes.

4-4.9. Load Characteristics. All of the lamps commonly used for outdoor lighting, except incandescent, use ballasts to control current to the lamp. Ballasts are available for each lamp type, in high power factor versions that will maintain power factor of the line at 90-95%. Power consumption by the ballast will be 15-25% of lamp wattage. Incandescent sources operate at 100% power factor and don't require ballasts; however there will be large inrush currents when tungsten filament lamps are energized. Although the current spikes are of short duration, they are high in magnitude (1500 to 1800% of normal operating current vs approximately 150% starting current for other types of lamps such as HPS). It is necessary that equipment serving incandescent lighting be fully rated for such duty - ie., contacts rated for tungsten filament loads, heavy duty lighting contactors, overcurrent devices, switches, etc.

4-4.10. Strobe Effect. This phenomenon results from the tendency of lamp output to follow the fluctuations of an alternating current wave form. It can cause moving objects to flicker and rotating machinery to appear to be at rest or turning slower than actual speed. The effect is most noticeable in an individual's peripheral vision rather than directly in front. For outdoor lighting it would tend to be a nuisance rather than a hazard. Stroboscopic effect is most pronounced with mercury vapor and some type of fluorescent lamps (or ballasts). HPS lamps are slightly less subject to it; metal halide lamps exhibit minimal effect. To counteract the effect, mercury and HPS lighting should be supplied by 3 phase power. The problem does not develop under incandescent lighting and apparently is minimal with low pressure sodium.

4-4.11. Safety and Environmental Considerations. Attention should be given to proper disposal of removed HID lamps. Sodium is somewhat volatile when exposed to water. Loose sodium should be neutralized before discarding. For recommended disposal procedures for LPS lamps, see Attachment 17 in Appendix A. There are no special hazards involved with disposal of HPS lamps other than what could be expected from careless handling of tubes. Mercury vapor lamps can cause harmful ultraviolet radiation burns if operated after the outer glass envelope has been broken. The required operating voltage of HID lamps tends to rise with age. When the ballast can no longer deliver sufficient voltage to maintain operation, mercury vapor and metal halide arcs will be extinguished. HPS ballasts will deliver a starting pulse to reignite, thus cycling on and off continuously.

4-4.12. TV Surveillance. Use of a closed circuit television system for outdoor surveillance requires that attention be given during design to the amount and type of lighting to be installed. If the light levels are too low, the camera is subject to image "burn-in" particularly if cameras are held in fixed positions. The result is that the particular image that remains on the TV monitor even though the scene in front of the camera may have changed. The spectral response of the light source also is a factor affecting the efficiency of the system. Since cameras are sensitive to average illumination, uniformity of lighting on the scene is important. Three types of tubes are generally available at present. The oldest is the antimony sulphide vidicon, the standard for the industry. It is most compatible with incandescent lighting; if other lamp types are employed, the relative illumination level must be increased to compensate (1.7 FC HPS equivalent to 1 FC incandescent, LPS 2 FC to 1 FC). The newer silicon vidicon is over 5 times more sensitive than the standard vidicon under incandescent lighting, almost 3 times when HPS is the source. The newest tube, the hetero-junction vidicon has a sensitivity ratio of 10:1 over the standard vidicon; 6:1 when using HPS lighting. The last tube, in addition to its better sensitivity for low light application, is more resistant to "blooming" (the brightest objects in a scene appear larger than actual size - the extent of the distortion being proportional to the relative brightness).

4-4.13. Restrictions on Mounting Position. For quartz iodine lamps, orientation of the longitudinal axis is critical. If the variation from horizon exceeds $\pm$ 4° lamp life will suffer appreciably. There are no restrictions in rotation about that axis other than insuring that floodlights aimed upward have been specifically designed for the extra heat load. Low pressure sodium lamps can be tilted up 20° maximum above horizontal and down to 90° below horizontal; however the base (socket end) of the lamp must serve as the pivot position not the opposite end. The most efficient operation and longest life will be obtained at or near horizontal particularly with the larger lamps (90 - 180W). High pressure sodium lamps manufactured by General Electric must be ordered in either "base up" or a "base down" versions. Lamps can be tilted 95° maximum from the vertical (to 5° above horizontal). If tilted beyond, the mercury sodium amalgam can spill out of its reservoir. Lamps of other manufacturers (except Westinghouse 1000 watt unit) may be operated in any burning position.

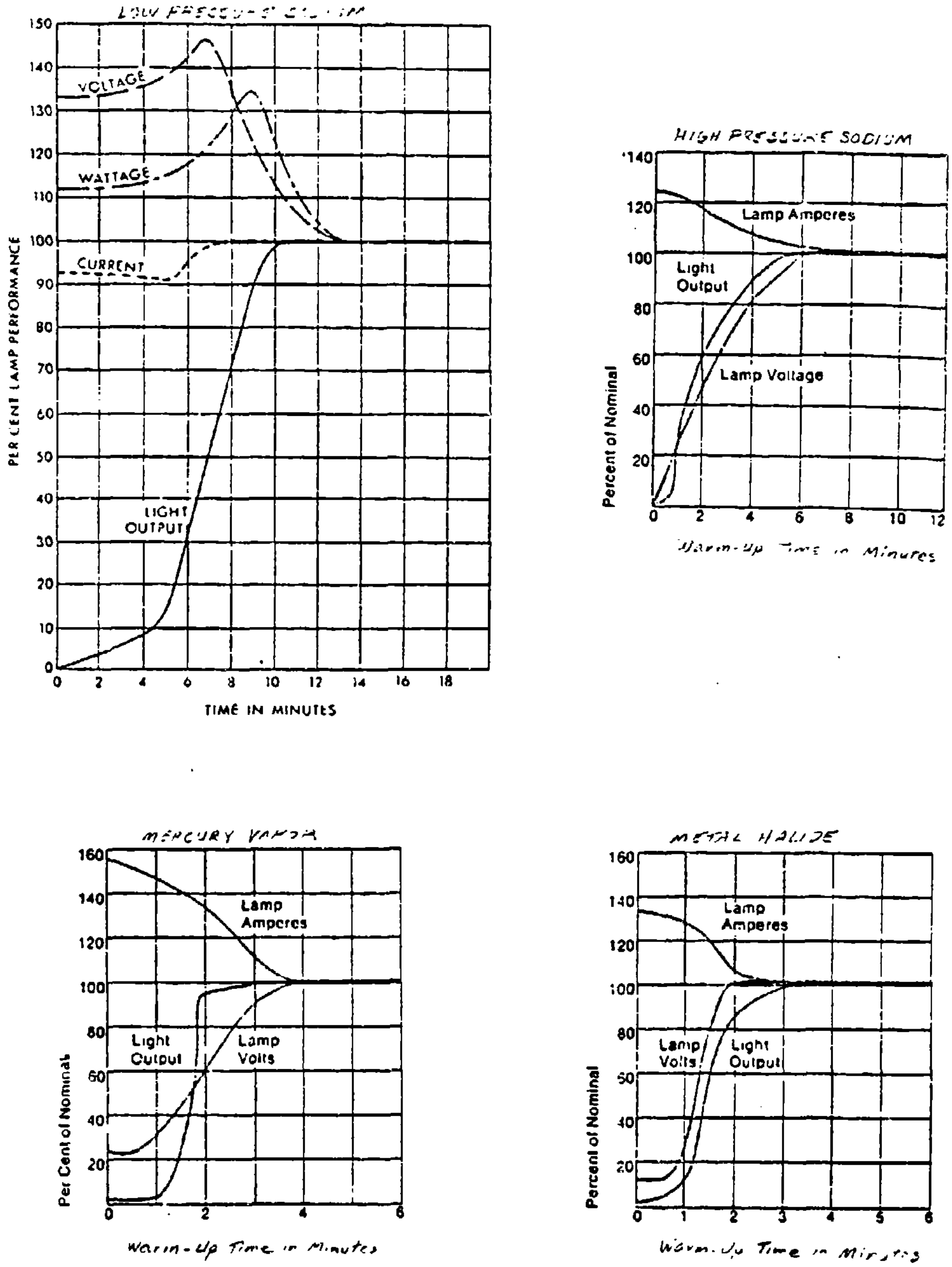
4-4.14. Miscellaneous Considerations. Low temperature operation has minimal effect on lumen output of most lamps but can interfere with starting. Low temperature ballasts are readily available for outdoor applications to compensate for temperature related starting difficulties (commonly rated at -20°F). Fluorescent lamps however do suffer significant lumen decrease as temperature drops. Large, long lamps such as fluorescent

or LPS present problems in designing housings that will provide efficient beam control. LPS, primarily because of its high efficacy has been used in floodlights, whereas with fluorescent this has not been done. Compact sources such as quartz and HPS are ideal for floodlighting applications. Manufacturing techiques employed in the production of incandescent and fluorescent lamps have been refined to the point that camp characteristics are quite uniform and are predictable with reasonable precision. With LPS and to a lesser extent, HPS there is more variance in performance parameters from one lamp to another off the production line. LPS lamps operate at relatively low temperatures (260°C/500°F) resulting in a minimum of breathing during fluctuations in ambient temperature; as a consequence these lamps have negligible dirt factors (0.90 to 0.95 typically). HPS lamps operate at comparatively higher temperatures (400°C/750°F) with poorer dirt factors (0.75-0.85). Some HPS floodlights and roadway units are available in filtered versions that are less subject to light degradation due to accumulations of dirt, film etc. on lenses, lamps and refractors (higher dirt factors, 0.85-0.90). The typical quartz lamp operates at temperatures exceeding 500°F.

	INCANDESCENT		FLUORESCENT		HIGH INTENSITY DISCHARGE (HID)				
	Filament	Quartz Iodine	Cold Cathode	Heated Cathode	Xenon	Mercury Vapor	Metal Halide	High Press Sodium	Low Press. Sodium
Efficacy-lamp only (lumens/watt)	12-20	20-23	50-65	55-75	20-50	40-65	80-100	95-140	131-183
Wattages Available	5-5000	45-5000	20-75	4-220	15-30,000	175-3000	175-1500	50-1000	35-180
Ballast Loss (watts for size __)	----	----	30 (2-40W)	15 (2-40W)	----	45-65 (400W)	55 (400W)	55-82 (400W)	40 (180W)
Lamp Life (hours for size __)	750 (100W)	2000 (1500W)	9000 (40W)	20000 (40W)	1000 (500W)	24000 (100-400W)	15000 (400W)	20000 (400W)	18000 (180W)
Time Interval to Restrike	Immediate	Immediate	Immediate	Immediate	Immediate	3-6 min.	10-20 min.	2 min. or less	Immediate to 2 min.
Time to Full Output (Initial or Restrike)	Immediate	Immediate	Immediate	Immediate	Immediate	3-7 min.	3-5 min.	3-4 min.	8-15m start Immed. to 5m. restrike
Color Rendition	Very Good	Very Good	Fair to Good	Fair to Good	Excellent	Blue-Green	Good	Gold-Yellow	Monochrom. Yellow
Beam Control	Very Good	Good	Poor	Poor	Very Good	Fair	Good	Good	Fair
Lamp Size	Compact	Compact	Extended	Extended	Compact	Medium	Medium	Compact	Extended
Comparative Fixture Cost	1	3	2	4	9	5	6	7	8
Comparative Operating Cost	8	7	6	5	9	4	3	2	1
Low Temperature Operation	Very Good	Very Good	Fair	Fair	Good	Good	Good	Good	Good
Advantages	Low Initial Cost	Instant Start	Low Cost	Long Life	Color, Beam Control	Long Lamp Life	Color, Efficiency	Efficiency	L/Watt high, Good Maint. Factor
Disadvantages	Short Life	Low Efficiency	Shape	Shape	Large ballast, safety	Starting	Restrike, Safety	Starting, Glare	Color

COMPARATIVE LAMP CHARACTERISTICS

FIGURE 5

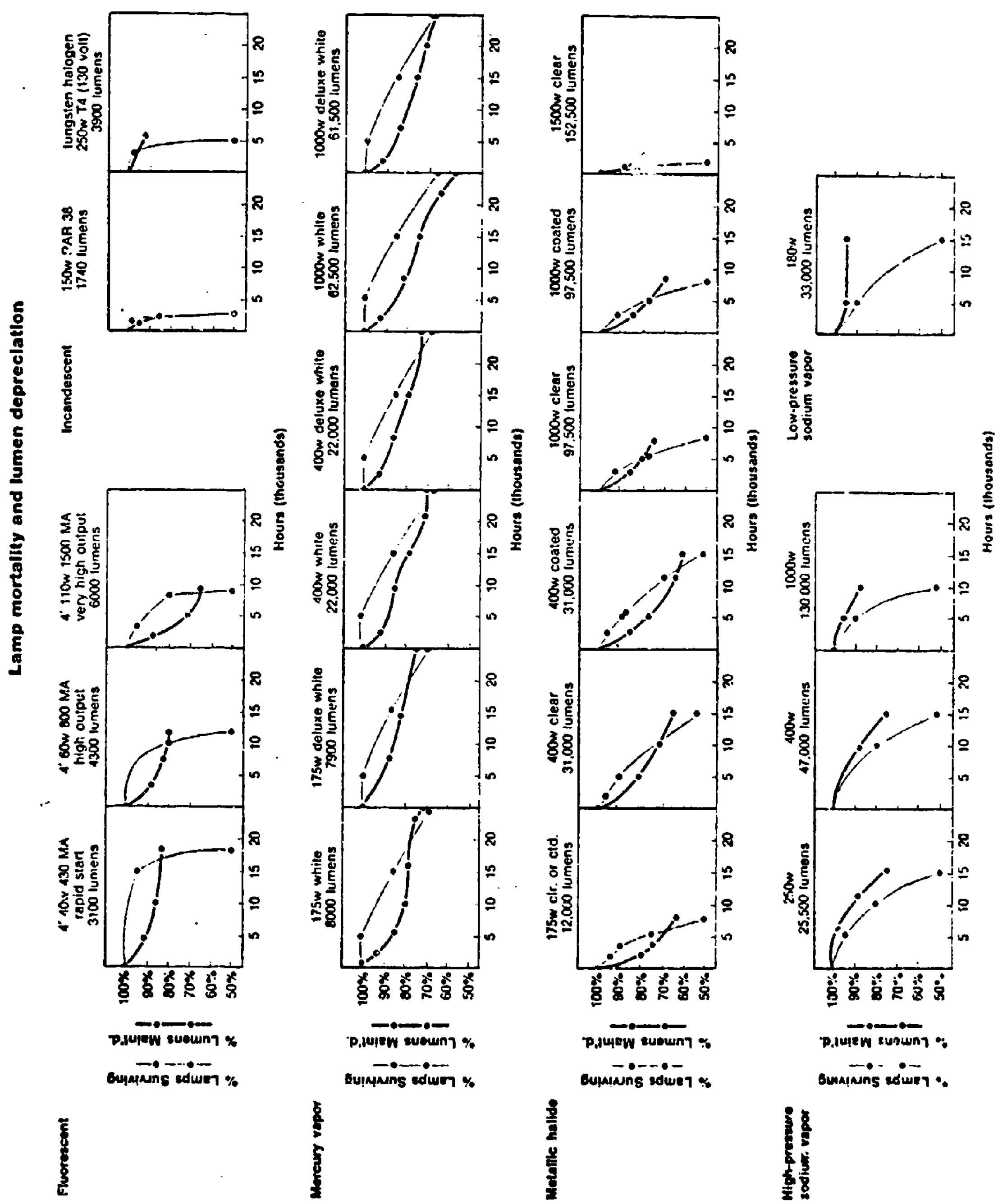


TYPICAL WARM UP TIMES ON INITIAL START

FOR HID AND LPS LAMPS

Data from Illum. Engrg. Soc. & Westinghouse

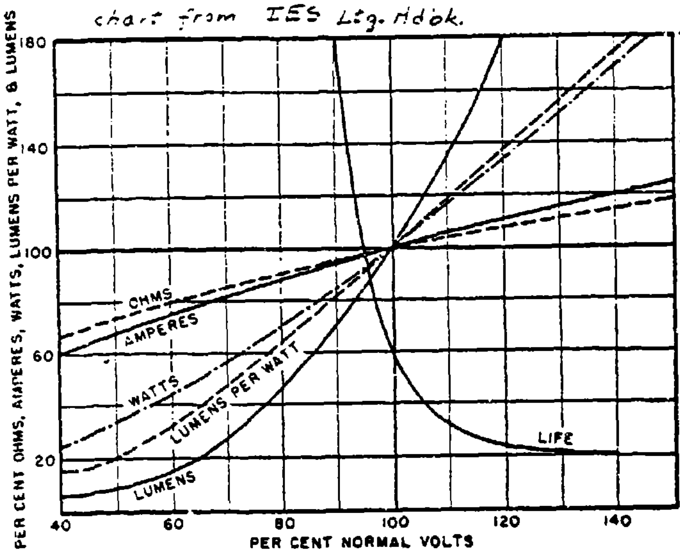
FIGURE 6



from N.E.C.A. Electrical Design Guidelines

Figure 7

chart from IES Ltg. Hdbk.



$L_1 = L_2 \left(\frac{V_1}{V_2}\right)^k$

$LE_1 = LE_2 \left(\frac{V_2}{V_1}\right)^d$

$k \approx 3.4$

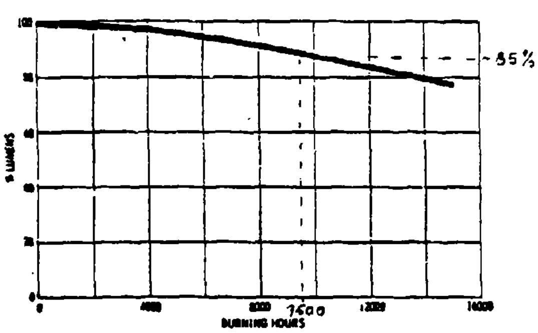
$d \approx 13$

V = voltage at lamp terminals

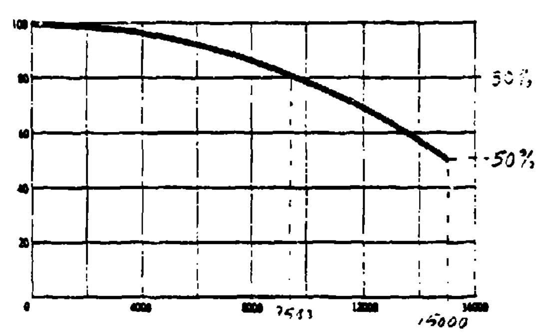
L = lumen output of lamp

LE = life expectancy of lamp

INCANDESCENT LAMP OPERATING CHARACTERISTICS



A. Lumen Maintenance



B. Lamp Mortality

From Graph B: Rated life = 15000 hours @ 50% mortality

Group Relamping Period = 9500 hours @ 20% mortality*

From Graph A: Lamp Lumen Depreciation (LLD) = 0.85 @ 9500 hours

* 20% lamp mortality was selected for this application.

LAMP CHARACTERISTICS - 250W HIGH PRESSURE SODIUM

(Lucalox #LU250) by Gen. Electric

LAMP PARAMETERS

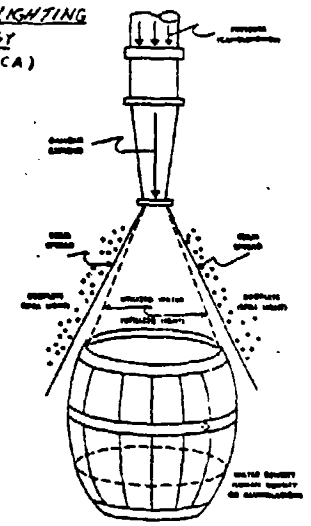
FIGURE 8

5. LIGHTING ANALYSIS:

5-1. Criteria. To properly evaluate the various potential lighting arrangements developed for each of the schemes described in Section 4, calculations of the footcandle output for each arrangement has to be made. The format specified in the original criteria was that computer printouts be provided to determine the extent to which each arrangement met the illumination criteria prescribed in Section 3. Calculations were to be based on the point by point method. Computer printouts were to show the calculated vertical or horizontal footcandle illumination at evenly spaced grid points throughout the defined area.

5-2. Lighting Theory. The unit "lumen" is used to identify the amount of light emitted from a light source. It represents the amount of luminous flux leaving the source. One lumen is defined as the flux contained within a unit solid angle emitted from a uniform point source of one candela. Illumination resulting from luminous flux falling on a surface is measured in footcandles. One lumen per square foot is numerically equivalent to one footcandle; one lumen per square meter is equivalent to one lux. One of the most significant factors in determining applicability of a particular luminaire to a specific task is its luminous intensity (candlepower) which is expressed as candela. This unit represents the intensity of the light source in a given direction. Intensities will have different values in different directions. The basis of most lighting calculations is the Inverse Square Law. It sets forth the following relationship: that the illumination at a point on a surface is directly proportional to the luminous intensity of the light in that direction and inversely proportional to the square of the distance from the source. This relationship is not valid for other than point sources, and for distances that are less than 5 times the largest dimension of the luminaire. See Figure 9 for additional information. Formulas, based on the Inverse Square Law, for computing illumination levels in vertical or horizontal footcandles are given in Figure 10. One determinant of quality lighting concerns its uniformity. Even illumination without dark areas or spots of high intensity light is the objective. The extent of variation is defined by the uniformity ratio, that is the average illumination (footcandles or lux) over a given area divided by the minimum value of illumination in that area.

HYDRAULIC-LIGHTING ANALOGY
(from NECA)



Corresponding Parameters

Hydraulic	Lighting
Nozzle	Luminaire
Gallons/Min	Lumens
Pressure	Candlepower
Beam Spread	Beam Spread
Droplets	Spill Light
Utilized Water	Utilized Light
Water Density (gallons/sq.ft.)	Lumen Density (lumens/sq.ft.)

One lumen uniformly distributed over one sq ft. of area produces an illumination level of one foot-candle.

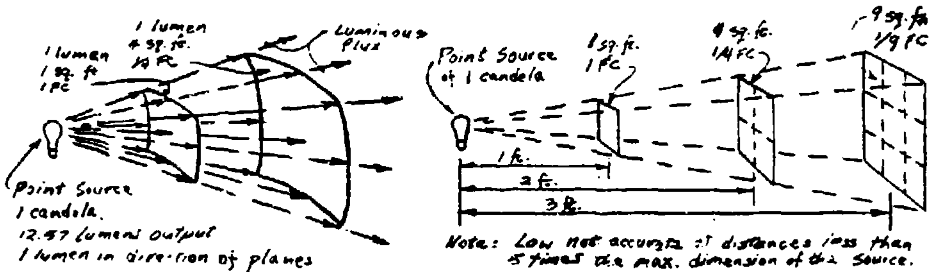
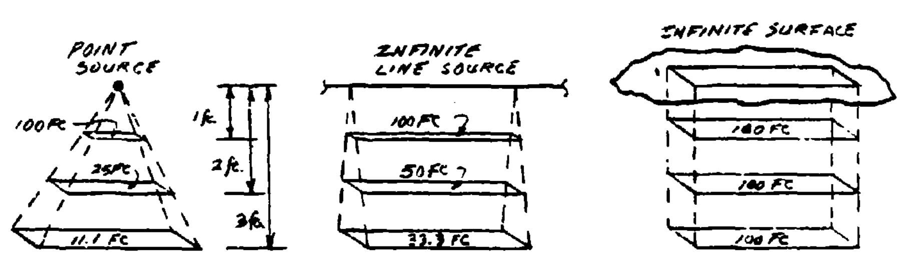


ILLUSTRATION OF INVERSE SQUARE LAW



Point Source: Illumination is inversely proportional to the square of the distance. Example: single luminaire

Line Source: Illumination is inversely proportional to the distance. Example: Row of fluorescent lamps

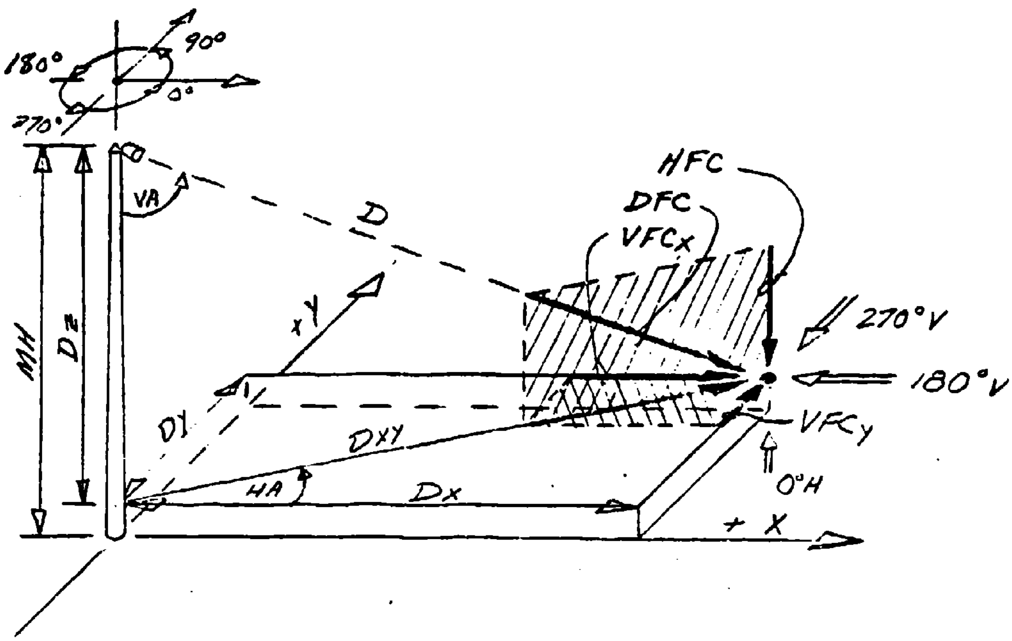
Surface Source: Illumination does not change with area. Example: Luminous ceiling

NOTE: Relationship is not accurate very near or extremely far from the source.

ILLUMINATION VS GEOMETRY OF THE SOURCE

BASIC LIGHTING RELATIONSHIPS

FIGURE 9



Definitions

D = Distance from luminaire to point (in ft)*

Dx, Dy, Dz = x, y, and z components of D

MH = Mounting height of luminaire (in ft)*

I = Intensity (candlepower) of the light source in a particular direction, in candelas

VFC, HFC, DFC = Illumination, in footcandles - vertical, horizontal, and direct, respectively

LLD = Lamp lumen depreciation

DF = Dirt factor

MF = Maintenance factor (MF = LLD x DF)

⟸ Identifies the orientation at which specific illum. calculations or measurements are based

Basic Relationships

Inverse square law: $FC \sim I/D^2$

Distance: $D = (Dx^2 + Dy^2 + Dz^2)^{\frac{1}{2}}$

POINT TO POINT ILLUMINATION CALCULATIONS

FIGURE 10
Sheet 1 of 2

General Illumination Formulas **

$$HFC = \frac{I \cdot D_z \cdot MF}{(D_x^2 + D_y^2 + D_z^2)^{3/2}}$$

$$VFC_y = \frac{I \cdot D_y \cdot MF}{(D_x^2 + D_y^2 + D_z^2)^{3/2}} = HFC \cdot \frac{D_y}{D_z}$$

$$VFC_x = \frac{I \cdot D_x \cdot MF}{(D_x^2 + D_y^2 + D_z^2)^{3/2}} = HFC \cdot \frac{D_x}{D_z}$$

Illumination Formulas for 2 Dimensional Application **

$(D_x = 0)$

$$HFC = \frac{I \cdot D_z \cdot MF}{(D_y^2 + D_z^2)^{3/2}}$$

$$VFC_y = \frac{I \cdot D_y \cdot MF}{(D_y^2 + D_z^2)^{3/2}} = HFC \cdot \frac{D_y}{D_z}$$

* If metric units (meters) are substituted, results of calculations will be in Lux (VLux, HLux, DLux). Values given in footcandles may be converted to lux by applying a multiplier of 10.76. A multiplier of 0.3048 will convert values given in feet to the equivalent in meters.

** If illumination calculations are to be made at ground level, "MH" may be substituted for "D_z".

POINT TO POINT ILLUMINATION CALCULATIONS

FIGURE 10
Sheet 2 of 2

5-3 Illumination Calculations. The point by point method of calculating illumination has proved most accurate. Formulas for the point by point calculation technique are given in Figure 10. Illumination may be determined on a horizontal basis or for any orientation of a vertical basis. The general formula will be most commonly used since most applications will be 3-dimensional. In certain special applications the simplified 2-dimensional formulas could find use. The effect of degradation in light output due to lamp aging or contamination is accounted for by the maintenance factor. An adjustment could also be included that would compensate for lamp operation at other than rated voltage or at low ambient temperatures, if desired. When applying these formulas, the contributions from several sources to the illumination at a point may be added directly in the case of horizontal footcandles. When calculations are made on a vertical footcandle basis, it is necessary that all contributions be resolved into components at the same orientation such as 270°. This is analagous to conducting all footcandle measurements with the photometer pointed in the same direction - such as perpendicular to the plane of a fence or a pole line.

5-4 Characteristics of Horizontal and Vertical Illumination. There are some basic distinctions that should be kept in mind with respect to the different illumination characteristics of vertically and horizontally based lighting. A floodlight type of luminaire mounted relatively close to the ground will yield the maximum vertical illumination on a particular point. Readings of horizontal footcandles, however, will be very low and will tend to drop off to zero the greater the distance out from the pole. A floodlight mounted relatively high will result in a much stronger horizontal illumination component at the point. It can be seen, therefore, that for a horizontal footcandle requirement, high mast lighting would illuminate an area more efficiently and evenly with fewer poles than would be the case for low mounting heights. Mounting height considerations are discussed in paragraphs 9-1.1 and 9-3.1. One idiosyncrasy of basing criteria on vertical footcandle measurement is that the illumination at the pole under the luminaire will always measure zero, since the vertical footcandle component is zero. The eye of an observer may perceive a high level of illumination however, since the horizontal component could be very high.

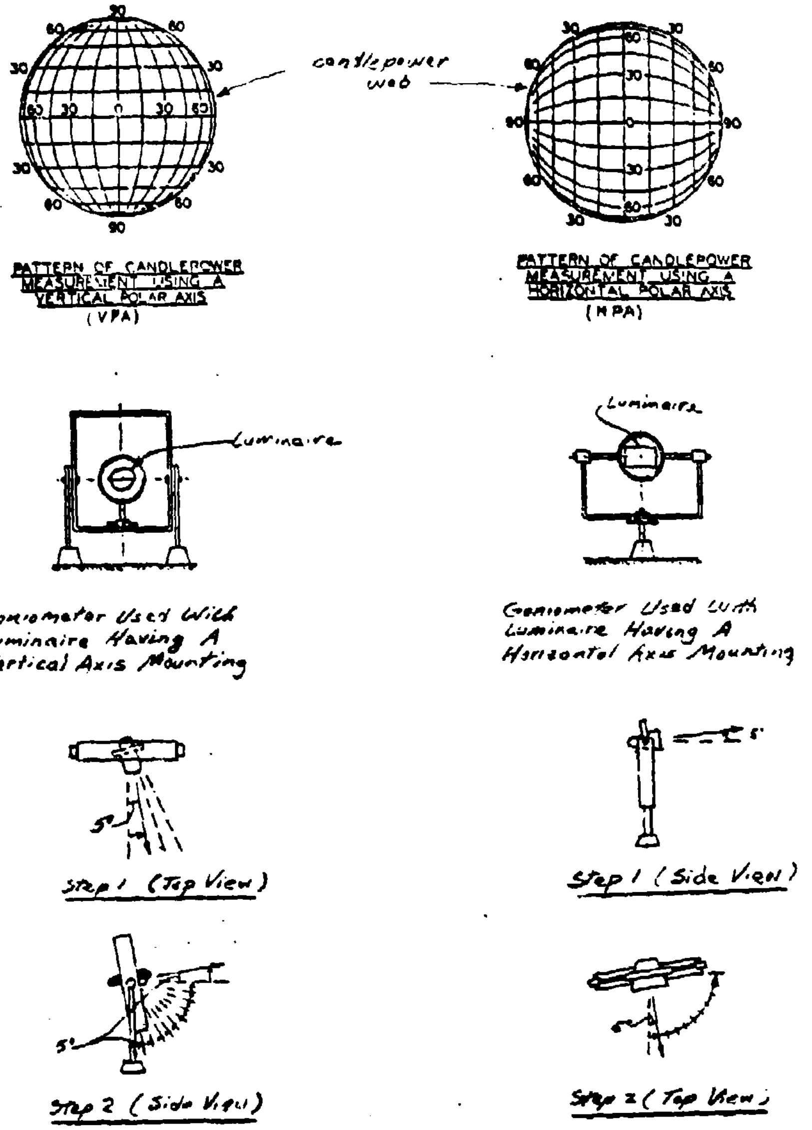
5-5 Candlepower Data.

5-5.1. General. Because of the directional characteristic of light intensity, each luminaire will have its own distinctive candlepower distribution pattern somewhat like a fingerprint. The variation in characteristics of a particular model from one unit to the next off the assembly line will depend on the control that can be maintained over the various manufacturing processes. Since most lighting calculations do not require an extreme degree of precision, a photometric test made on one or two random units should be valid for all units of that particular model luminaire. Accuracy, including minor error due to midpoint interpolation of candlepower values, should be better than 5% in most cases. (The margin of error could possibly extend to 10% for some low pressure sodium luminaires. Operating voltage and temperature could have an effect in some cases - note 4-3.3 and 4-4.5).

Most manufacturers perform informal abbreviated tests during development of a prototype; once the decision has been made to go into production, one or more units are pulled off the assembly line and sent to a recognized testing laboratory for a formal test. Some of the larger manufacturers have their own in house test laboratories.

5-5.2. Test Procedure. Virtually all tests in this country are conducted in accordance with the procedures recommended by the Illuminating Engineering Society (IES) in their published standards. There are two recognized test configurations: one in which the polar axis (axis of rotation) is horizontal, the other in which the polar axis is vertical. The horizontal polar axis (HPA) test format is almost universally used for examining floodlights. The vertical polar axis (VPA) procedure is applied to roadway luminaires, fluorescent, high mast, and most wall mount units. Steps in the test procedures are illustrated in Figure 11. The smaller the increment at which readings are taken the more accurate the candlepower data will be. For narrow beam floodlights 1° intervals may be advisable. For wide beam floodlights, 10° intervals are preferred. IES recommends that mid-zone angles (5°, 15°, 25°, etc) be selected for taking measurements so that the data could be used in the computation of lumens by the zonal method without additional manipulation.

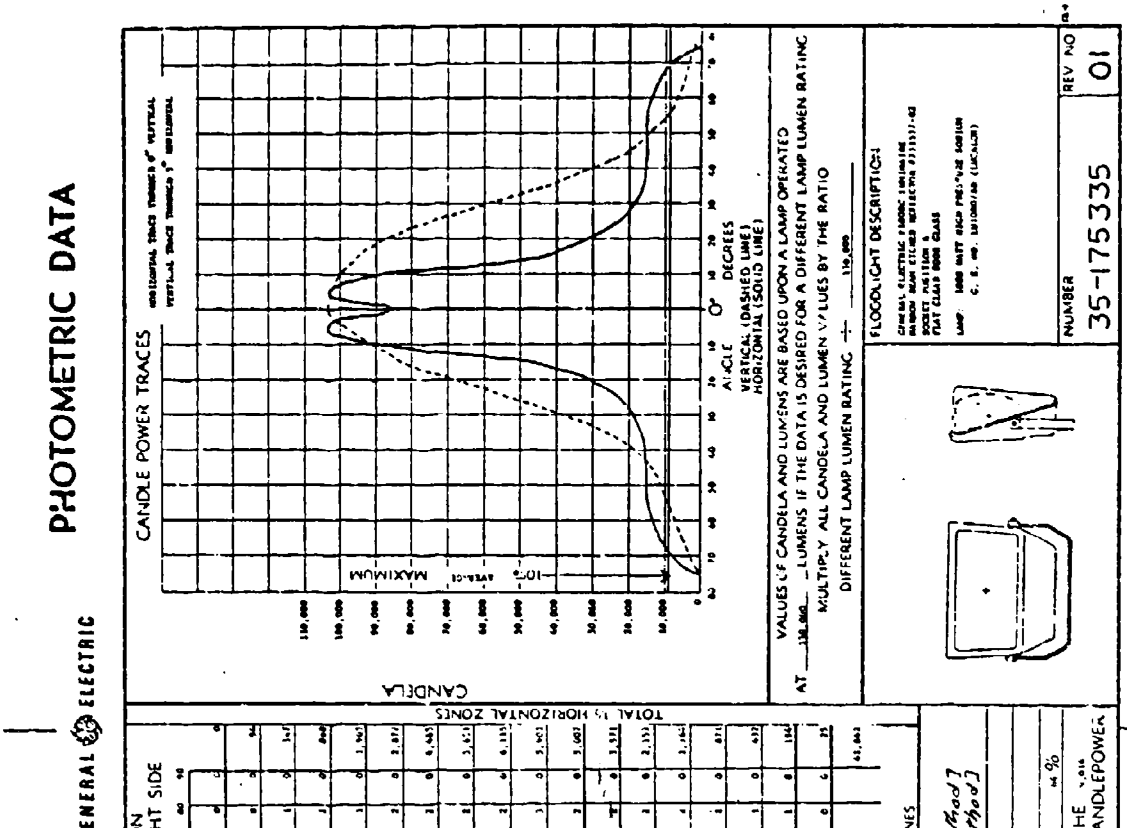
5-5.3. Data Format. Photometric data is available from manufacturers in a variety of formats. The most convenient, and the most accurate for computer calculations, is the raw test data in tabular form (similar to Figure 14 and sheet 3 of Figure 15). An example of the standard IES NEMA reporting format (floodlights and other horizontal polar axis units) is shown in Figure 12. Isocandeia curves have been plotted from candlepower test data on the left half of the diagram respresenting the luminaire, lumens have been calculated and listed on the right half. These lumen figures may be converted to candelas by the technique given in Figure 13. The table of Figure 14 shows the lower half vertical angles as negative. Other organizations make the lower half positive while some identify vertical angles as "upper" or "lower". The isocandla chart portrayed on Figure 15, sheet 1 constitutes recommended IES reporting format for roadway luminaires. The plot of critical distribution values such as 1/2 maximum candlepower and maximum candlepower aids in identifying the beam distribution category to which the luminaire belongs. One short-coming of data in the form of isocandela curves is that it can be difficult to interpolate values between curves with accuracy, particularly if a small scale graph is used. A single candlepower distribution curve, in a single plane will not be of value for point by point calculations unless the particular luminaire should happen to have symmetrical distribution such as IES type V. (Note: When requesting data from local representatives of luminaire manufacturers, it must be stressed that the data must be candlepower measured 3 dimensionally, in 4 or more planes. Since this data often has to be obtained from the factory, a better response can often be obtained by contacting the concern's lighting applications engineer direct.)



For the first cycle, the luminaire is adjusted 5° (Step 1) and candlepower readings are then taken at the 5°, 15°, 25°, 35°, 45°, 55°, 65°, 75° and 85° intervals about the other axis (Step 2). For the second cycle, the luminaire is set at 15° (Step 1) and Step 2 readings repeated. The angle notation shown is IES format.

PROCEDURE SPECIFIED BY ILLUMINATING ENGINEERING SOCIETY (IES) FOR CANDLEPOWER MEASUREMENTS
(10°H x 10°V zone format shown)

FIGURE 11



PHOTOMETRIC DATA FOR FLOODLIGHT
STANDARD IES-NEMA REPORTING FORMAT

FORMAT 12

CONVERSION METHOD
LUMENS TO CANDLEPOWER

1. Basic formula: $CP = L/K_z$

(Based on zonal lumen method with photometric data in standard IES reporting format per FIGURE 12)

2. Zonal constant formulas:

$K_z = \frac{\phi\pi}{180}(\sin\theta_2 - \sin\theta_1)$ [general formula]

$K_z = \frac{2\pi\phi}{180}\sin P(\cos\theta_m)$ [shortcut method]

3. Definitions:

ϕ = interval of vertical zones, in degrees.

θ_1, θ_2 = limits of the particular horizontal interval in degrees.

P = ½ of the horizontal interval in degrees.

θ_m = the median angle for each horizontal interval calculated.

CP = candlepower, in candela

L = lumens.

4. Typical Multipliers:

$K_z = \frac{2\pi\phi}{180}\sin P\cos\theta_m = \frac{2\pi(4)}{180}\sin(2)\cos\theta_m.$

$= 0.004873 \cos\theta_m$ (4° vertical, 4° horizontal)
$= 0.007309 \cos\theta_m$ (6° vertical, 4° horizontal)
$= 0.01096 \cos\theta_m$ (6° vertical, 6° horizontal)
$= 0.01948 \cos\theta_m$ (8° vertical, 8° horizontal)
$= 0.03042 \cos\theta_m$ (10° vertical, 10° horizontal)

5. Example – Conversion constants for 10°V x 10°H:

θ_m	5	15	25	35	45	55	65	75	85
K_z	0.0303	0.0294	0.0276	0.0249	0.0215	0.0174	0.0129	0.0079	0.0027

All of the lumen values in the horizontal column, from 85° lower to 0° to 85° upper, would be divided by 0.0304, the 15° column by 0.0294, etc. (See FIGURE 12 ,

FIGURE 13

INDEPENDENT TESTING LABORATORIES, INC.

3386 Longhorn Road, Boulder, Colorado 80302

Phone 442-1255, Area Code 303

REPORT NO. 16969
DATE 8-6-73

SHEET 5 (SUPPLEMENTARY CP DATA)
AVERAGE OF RIGHT AND LEFT SIDES

PREPARED FOR KEENE CORP. STONCO LIGHTING . CAT. NO. CPH-1515, 1500W QUARTZ, NEMA 6 x 5 BEAM

POLAR AXIS HORIZONTAL

VERTICAL MIDZONE ANGLES	HORIZONTAL MIDZONE ANGLES								
	0.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
60.0	290.	301.	291.	270.	304.	219.	167.	130.	83.
52.0	580.	673.	693.	572.	1076.	663.	293.	227.	112.
44.0	4446.	4185.	2841.	2935.	2881.	1954.	842.	378.	144.
36.0	5703.	5380.	5272.	5064.	4105.	2979.	1544.	510.	177.
28.0	7395.	7103.	7025.	6619.	5596.	3961.	2123.	621.	209.
20.0	10488.	10080.	10155.	9368.	8101.	5482.	2743.	690.	239.
12.0	16723.	16092.	16043.	14394.	12209.	8016.	3691.	728.	259.
4.0	25858.	24649.	24433.	21261.	17277.	10482.	4316.	760.	265.
0.0	27018.	26052.	26028.	22613.	18681.	11576.	5099.	749.	265.
-4.0	25230.	24047.	23733.	20626.	16784.	10312.	4288.	780.	265.
-12.0	16337.	15704.	15620.	14070.	11915.	7893.	3704.	768.	260.
-20.0	10343.	9954.	9955.	9282.	8061.	5479.	2832.	709.	241.
-28.0	7250.	6936.	6894.	6579.	5619.	3973.	2138.	623.	211.
-36.0	5316.	5090.	5033.	4934.	3907.	2886.	1504.	507.	179.
-44.0	1933.	1566.	1771.	2776.	1361.	1786.	811.	368.	146.
-52.0	531.	547.	543.	520.	402.	607.	282.	207.	113.
-60.0	290.	300.	308.	309.	20[illegible]	203.	183.	122.	82.

ZONE FORMAT: 8° VERTICAL SPACING x 10° HORIZONTAL INTERVAL

FIGURE 14 PHOTOMETRIC DATA : CANDLEPOWER TABLE

ENVIRONMENTAL RESEARCH LABORATORIES

3410 E. HELM DRIVE, THUNDERBIRD INDUSTRIAL AIRPARK, SCOTTSDALE, ARIZONA 85260 TELEPHONE (602) 948-3471

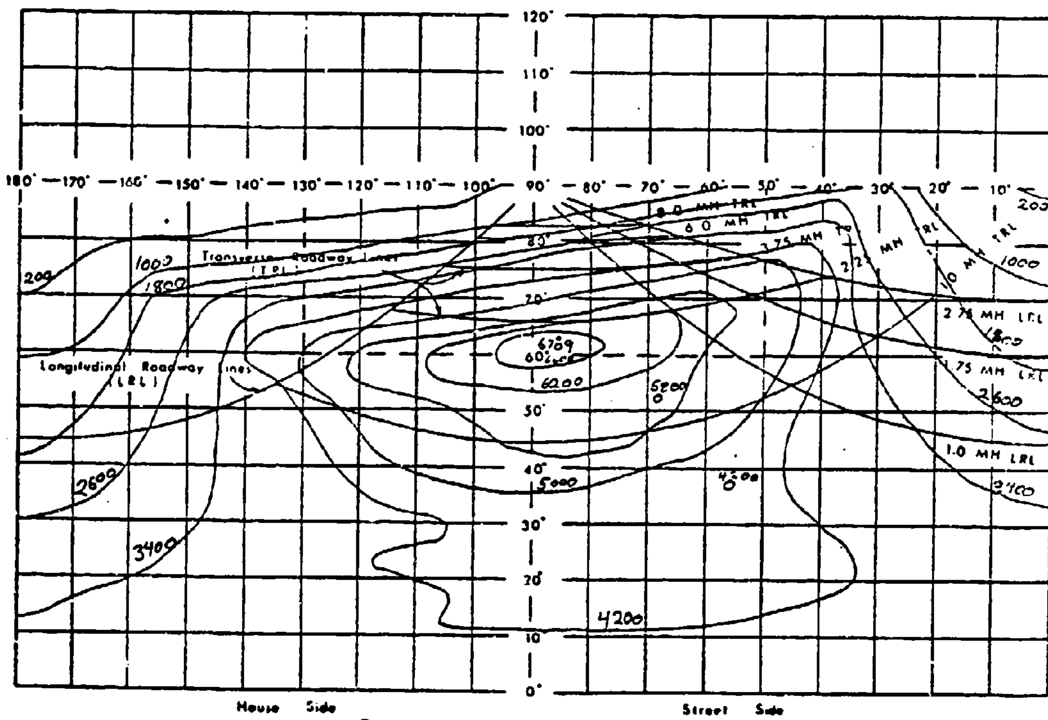
CERTIFIED TEST REPORT NO. ERL 1924

ITT LOW PRESSURE SODIUM LUMINAIRE, CAT. NO. 67-12184
UPPER LAMP POSITION
ONE 180 WATT LOW PRESSURE SODIUM LAMP, RATED 33,000 LUMENS

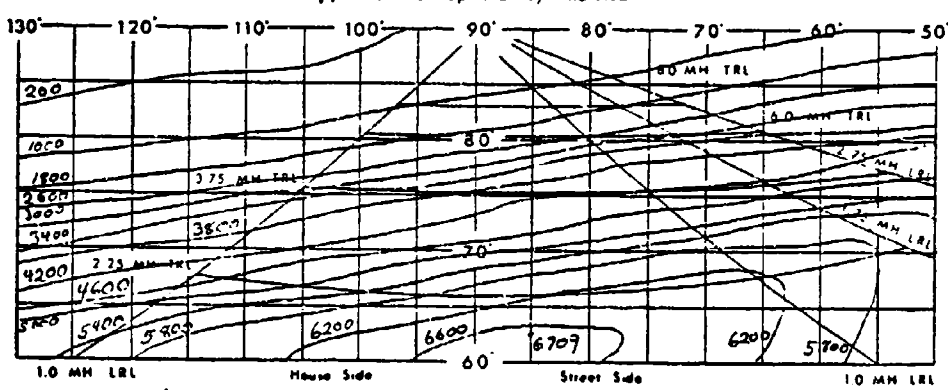
****** LUMINAIRE TILTED 10.00 DEGREES ******

POLAR AXIS: VERTICAL

ISOCANDELA CHART



Opposite hemisphere symmetrical



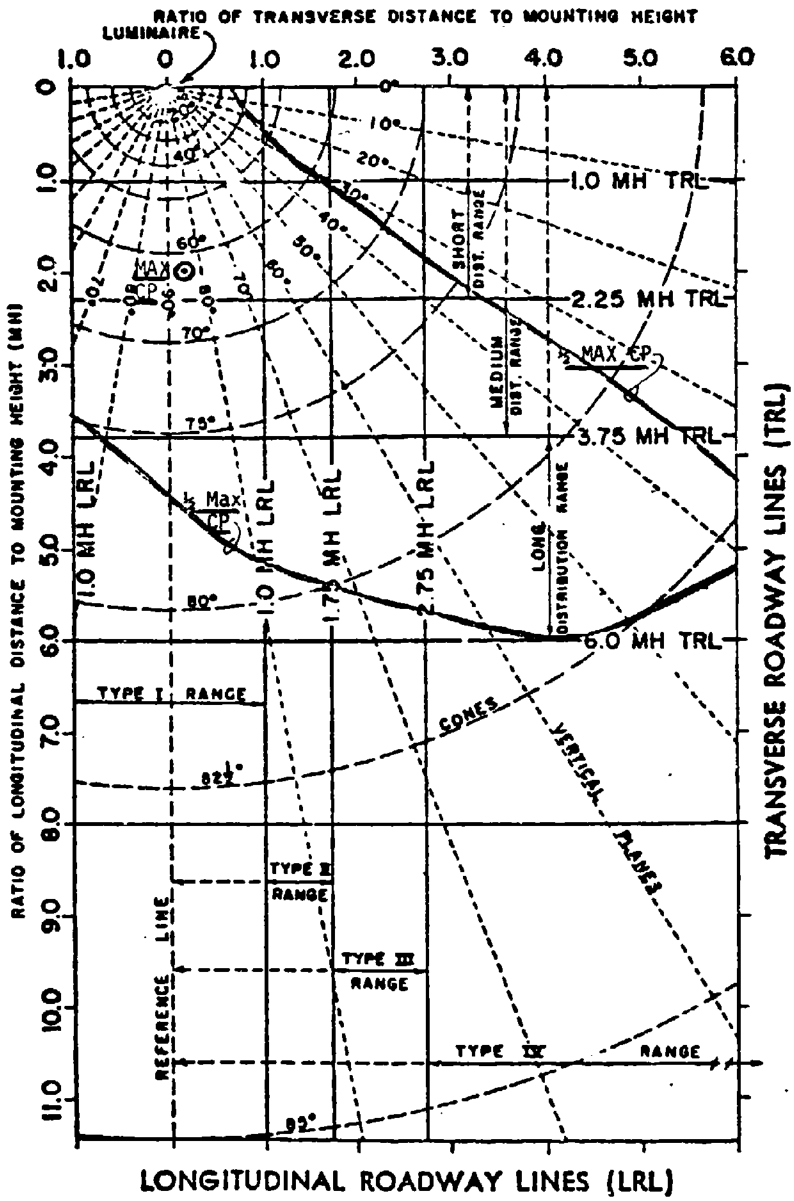
ENLARGED SECTION

PHOTOMETRIC DATA FOR ROADWAY LUMINAIRE

FIGURE 15
Sheet 1 of 3

ENVIRONMENTAL RESEARCH LABORATORIES

7410 E. HELM DRIVE, THUNDERBIRD INDUSTRIAL AIRPARK, SCOTTSDALE, ARIZONA 85260 TELEPHONE: (602) 948-3471



Test No. ERL1924 IES CLASSIFICATION : TYPE IV SHORT NON-CUTOFF

FIGURE 15
Sheet 2 of 3

ENVIRONMENTAL RESEARCH LABORATORIES INC.
7410 E. HELM DRIVE, THUNDERBIRD INDUSTRIAL AIRPARK
SCOTTSDALE, ARIZONA 85260.

CERTIFIED TEST REPORT NO. ERL 1924

ITT LOW PRESSURE SODIUM LUMINAIRE, CAT. NO. 67-12184
UPPER LAMP POSITION
ONE 180 WATT LOW PRESSURE SODIUM LAMP, RATED 33,000 LUMENS
****** LUMINAIRE TILTED 10.00 DEGREES ******
MEAN CANDLEPOWER IN STANDARD ZONES

HORIZONTAL ANGLES	VERTICAL ANGLES								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.	3849.	3842.	3726.	3356.	2787.	2036.	1462.	947.	376.
15.	3850.	3903.	3909.	3582.	3121.	2556.	2030.	1345.	700.
25.	3850.	4020.	4155.	3906.	3579.	3103.	2711.	2178.	1909.
35.	3856.	4125.	4299.	4163.	3811.	3619.	3600.	3551.	2745.
45.	3867.	4210.	4306.	4316.	4116.	4554.	4761.	5008.	2768.
55.	3875.	4263.	4324.	4326.	4805.	5388.	5758.	5167.	2564.
65.	3879.	4299.	4430.	4343.	5505.	5806.	6214.	4732.	2036.
75.	3877.	4321.	4439.	4531.	5854.	6145.	6330.	4374.	1548.
85.	3886.	4364.	4446.	4672.	5881.	6322.	6179.	3951.	1112.
95.	3889.	4265.	4423.	4724.	5870.	6398.	5986.	3692.	630.
105.	3883.	4109.	4318.	4572.	5634.	6245.	5660.	3094.	433.
115.	3866.	4044.	4182.	4277.	5179.	5848.	5212.	2593.	329.
125.	3839.	3964.	3990.	3889.	4469.	5142.	4797.	2179.	0.
135.	3804.	3872.	3782.	3631.	3724.	4100.	4251.	1770.	0.
145.	3781.	3737.	3600.	3394.	3128.	2977.	3313.	1445.	0.
155.	3756.	3587.	3290.	3012.	2652.	2228.	2027.	984.	0.
165.	3729.	3471.	3049.	2565.	2146.	1591.	954.	521.	0.
175.	3733.	3381.	2910.	2229.	1702.	1233.	592.	62.	0.

LUMENS IN STANDARD ZONES

HORIZONTAL ANGLES	VERTICAL ANGLES								
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
5.	10.	30.	48.	58.	60.	51.	40.	28.	11.
15.	10.	31.	50.	62.	67.	64.	56.	40.	21.
25.	10.	32.	53.	68.	77.	77.	75.	54.	58.
35.	10.	33.	55.	72.	82.	90.	99.	104.	83.
45.	10.	33.	55.	75.	88.	113.	131.	147.	84.
55.	10.	34.	55.	75.	103.	134.	159.	152.	78.
65.	10.	34.	57.	76.	118.	145.	171.	139.	62.
75.	10.	34.	57.	79.	125.	153.	175.	129.	47.
85.	10.	34.	57.	81.	126.	157.	171.	116.	34.
95.	10.	34.	57.	82.	126.	159.	165.	109.	19.
105.	10.	32.	55.	80.	121.	156.	156.	91.	13.
115.	10.	32.	54.	74.	111.	146.	144.	76.	10.
125.	10.	31.	51.	68.	96.	128.	132.	64.	0.
135.	10.	31.	48.	63.	80.	102.	117.	52.	0.
145.	10.	30.	46.	59.	67.	74.	91.	42.	0.
155.	10.	28.	42.	52.	57.	55.	56.	29.	0.
165.	10.	27.	39.	45.	46.	40.	26.	15.	0.
175.	10.	27.	37.	39.	36.	31.	16.	2.	0.

FIGURE 15
Sheet 3 of 3

5-6 Luminaire Beam Distribution. Although there are applications where general, uncontrolled illumination is suitable, optimum performance in a given application is obtained when a lighting arrangement has been designed using a luminaire with precisely defined beam characteristics. Factors affecting beam control are the design of the reflector and the lens or refractor and the position of the lamp relative to these components. Effects of these factors for incandescent luminaires is illustrated in Figure 16. The industry has developed classification standards to identity specific beam categories. For projected beam units such as floodlights and searchlights there are seven defined NEMA Beam spreads from very narrow to very wide. Beam spread width is measured from the limits of the isocandela line corresponding to 10% of maximum candlepower. This method has been in effect since 1971. The 1952 IES method determined beam spread by measuring the isocandela line corresponding to 10% of the average maximum candlepower. Beam spread per the 1971 IES method is usually 2-5° less than that obtained with the 1952 method. NEMA beam types and the corresponding beam spreads in degrees is given in Figure 16. There is a different set of beam distribution categories applicable to some of the vertical polar axis luminaires such as roadway and high mast units. Illumination is classified according to the proportion of light directed to the front and to the sides of the luminaire and above a defined cutoff line. For street lighting applications, IES type III, medium, semicutoff is most commonly used. A general pattern in which illumination is equal in all directions (IES type V) is most suitable for high mast lighting and area lighting. The various categories are identified in Figures 17 and 18.

5-7 Effect of Distance on Illumination Level. Illumination on a point decreases significantly as the distance from the light source to the point is increased. The extent is determined by the inverse square law. The relationship is directly proportional for configurations involving a single pole and direct illumination (i.e. the footcandles in the direction of the ray(s) from the source to the point(s)). The theoretical curve (dashed line) of Figure 19 corresponds to this condition. The situation is more complex when several poles are involved and a component of illumination is considered. The solid curves on sheets 1 and 2 illustrate the relationships applicable at 4 different relative mounting heights. The figures shown for base mounting height and spacing apply to the computer trials used to develop the curves. The relationships between relative mounting height, spacing, and illumination, however, should be valid using any other reference figures. These curves could also be of use in determining the adjustment necessary to adopt the area lighting application curves (discussed in Section 9-2) to a revised illumination criteria value (i.e. 0.4 footcandle minimum to 0.3 or 0.5).

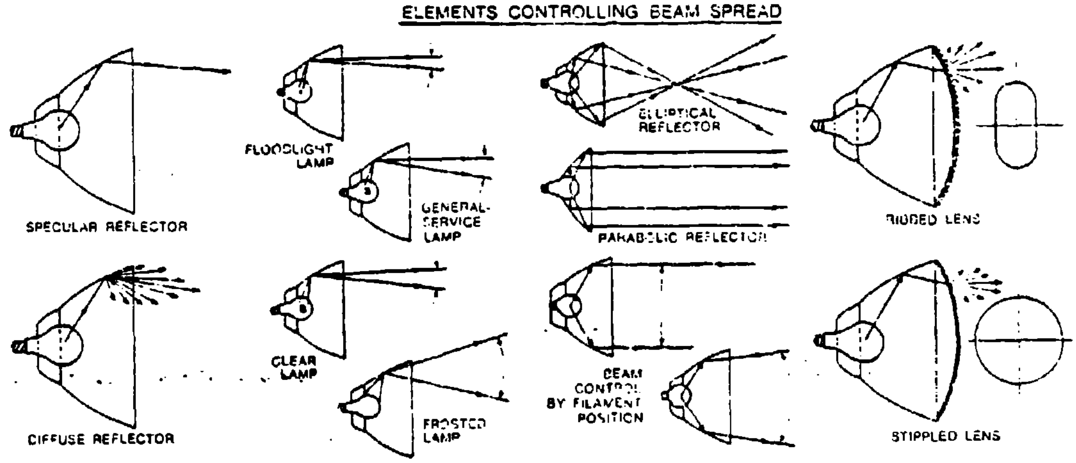
FLOODLIGHT LUMINAIRE TYPES

BEAM SPREAD DEGREES	NEMA TYPE	BEAM DESCRIPTION	MINIMUM BEAM EFFICIENCY, % INCANDESCENT TUNGSTEN-HALIDE	HIGH INTENSITY DISCHARGE
10 Up to 18	1	Very Narrow	38	—
18 Up to 29	2	Narrow	40	30
29 Up to 46	3	Medium Narrow	46	34
46 Up to 70	4	Medium	50	38
70 Up to 100	5	Medium Wide	54	42
100 Up to 130	6	Wide	56	46
130 and UP	7	Very Wide	60	50

Above from NEMA Standard FA1-1973

Example: A floodlight with a rectangular beam pattern such as 75° horizontal, 35° vertical, would be designated NEMA Type 5x3

ELEMENTS CONTROLLING BEAM SPREAD



From *ACTUAL SPECIFYING ENGINEER*, JULY 1972

FLOODLIGHTING DATA

FIGURE 16

IES "Type" classification

Type I: ½ maximum candela line enters the area on both sides of reference line (zero MH LRL) and **remains within** the area bounded by 1.0 MH LRL on both house and street sides in the **transverse zone of maximum candela.**

Type II: ½ maximum candela line does not cross the 1.75 MH LRL on the street side in the **transverse zone of maximum candela.**

Type III: ½ maximum candela line enters area bounded by the 1.75 MH LRL to the 2.75 MH LRL on the street side in the **transverse zone of maximum candela.**

Type IV: ½ maximum candela line crosses the 2.75 MH LRL in the **transverse zone of maximum candela.**

Type V: When the pattern has circular symmetry of candela distribution and is essentially the same at all lateral angles.

Control of Distribution Above Maximum Candlepower.

Cutoff. A luminaire light distribution is designated as cutoff when the candlepower per 1000 lamp lumens does not numerically exceed 25 (2½ per cent) at an angle of 90 degrees above nadir (horizontal); and 100 (10 per cent) at a vertical angle of 80 degrees above nadir. This applies to any lateral angle around the luminaire.

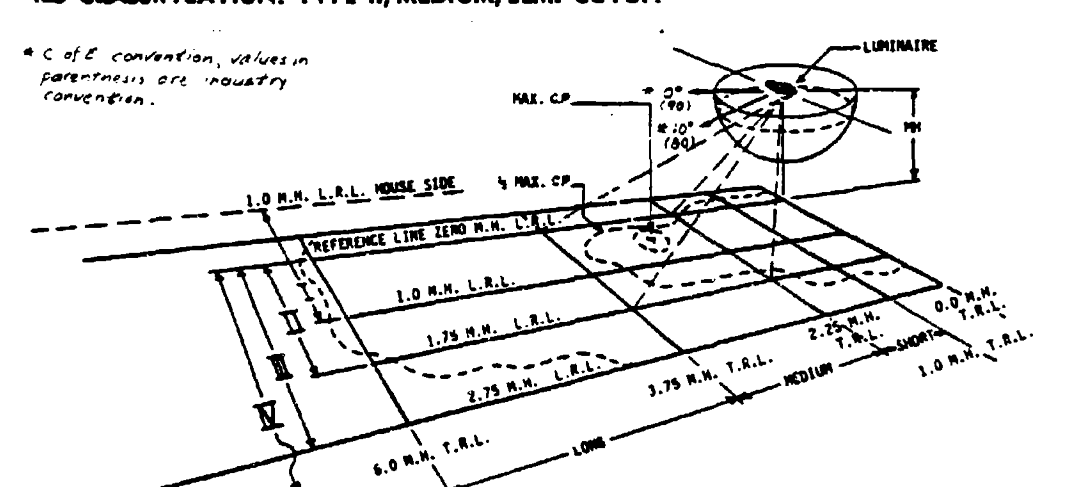
Semicutoff. A luminaire light distribution is designated as semicutoff when the candlepower per 1000 lamp lumens does not numerically exceed 50 (5 per cent) at an angle of 90 degrees above nadir (horizontal); and 200 (20 per cent) at a vertical angle of 80 degrees above nadir. This applies to any lateral angle around the luminaire.

Noncutoff. A luminaire light distribution is designated as noncutoff when there is no candlepower limitation in the zone above maximum candlepower.

TRL = Transverse Roadway Line
LRL = Longitudinal Roadway Line
candlepower (cp) = light intensity in candelas.

REFERENCES:
IES Lighting Handbook, 5th Edition
IES Std # RP-8 "American National Standard Practice for Roadway Lighting"
General Electric publication # GET3100G

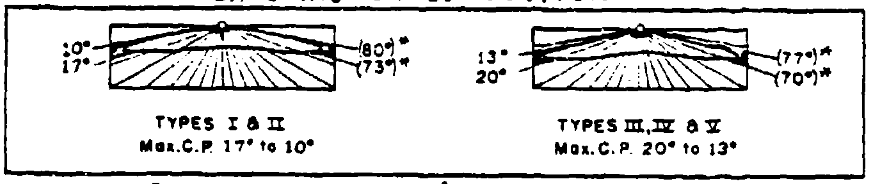
IES CLASSIFICATION: TYPE II, MEDIUM, SEMI CUTOFF



BEAM DISTRIBUTION CLASSIFICATION · ROADWAY LIGHTING

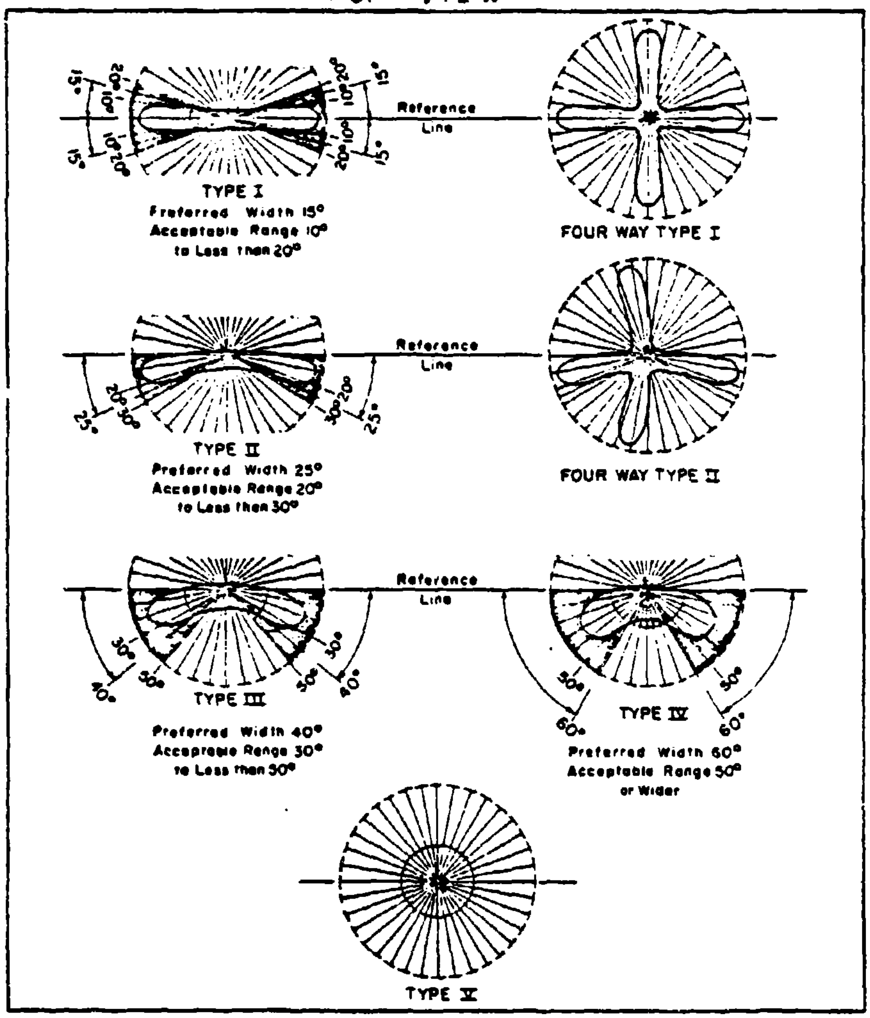
FIGURE 17

LATERAL CROSS SECTION



* Industry Convention for roadway luminaires

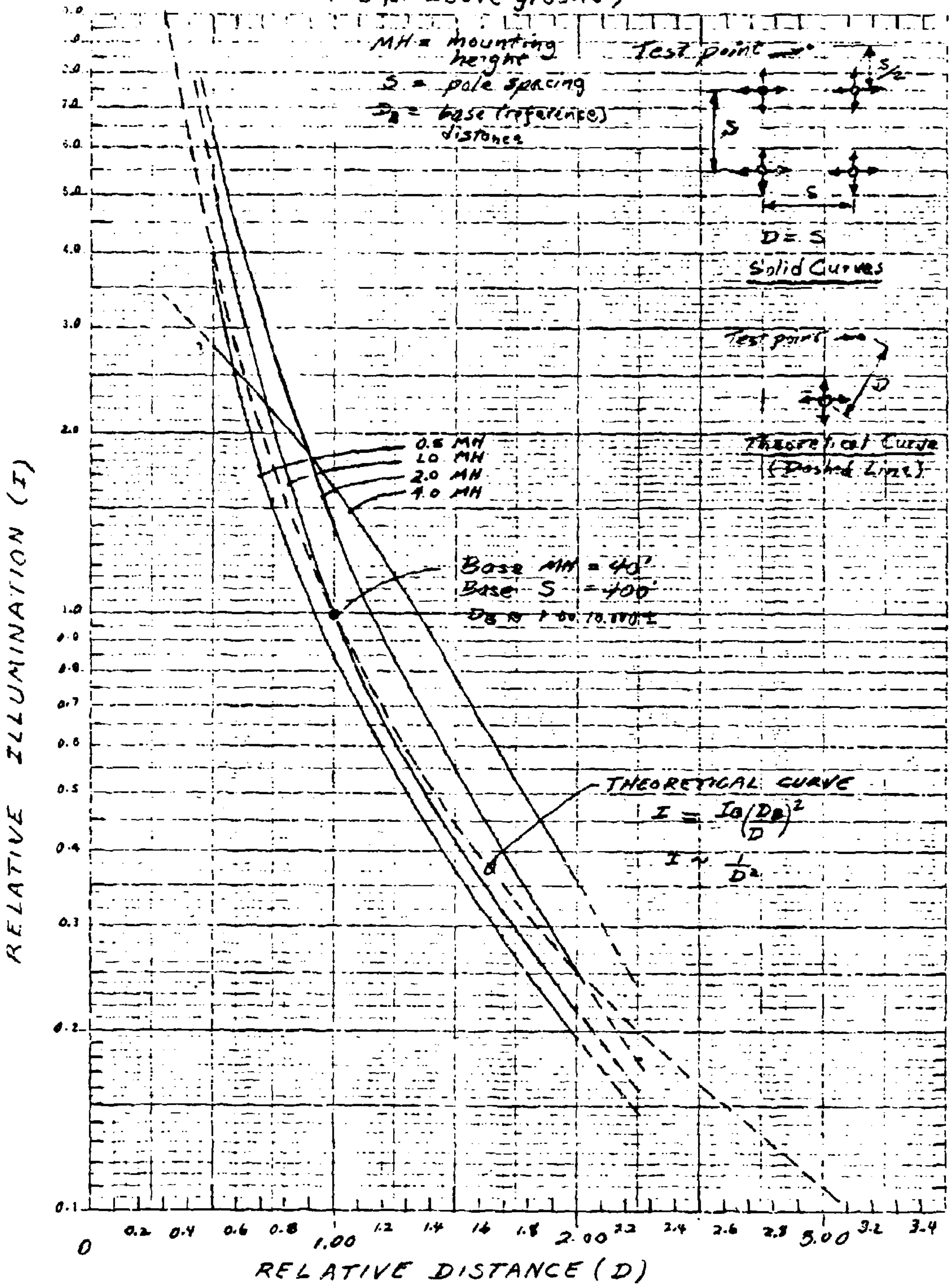
TOP VIEW



IES BEAM DISTRIBUTION PATTERNS - ROADWAY LIGHTING

FIGURE 12

ILLUMINATION VS DISTANCE
VERTICAL ILLUMINATION @ 270°
(3 ft. above ground)



43

FIGURE 19
Sheet 1 of 2

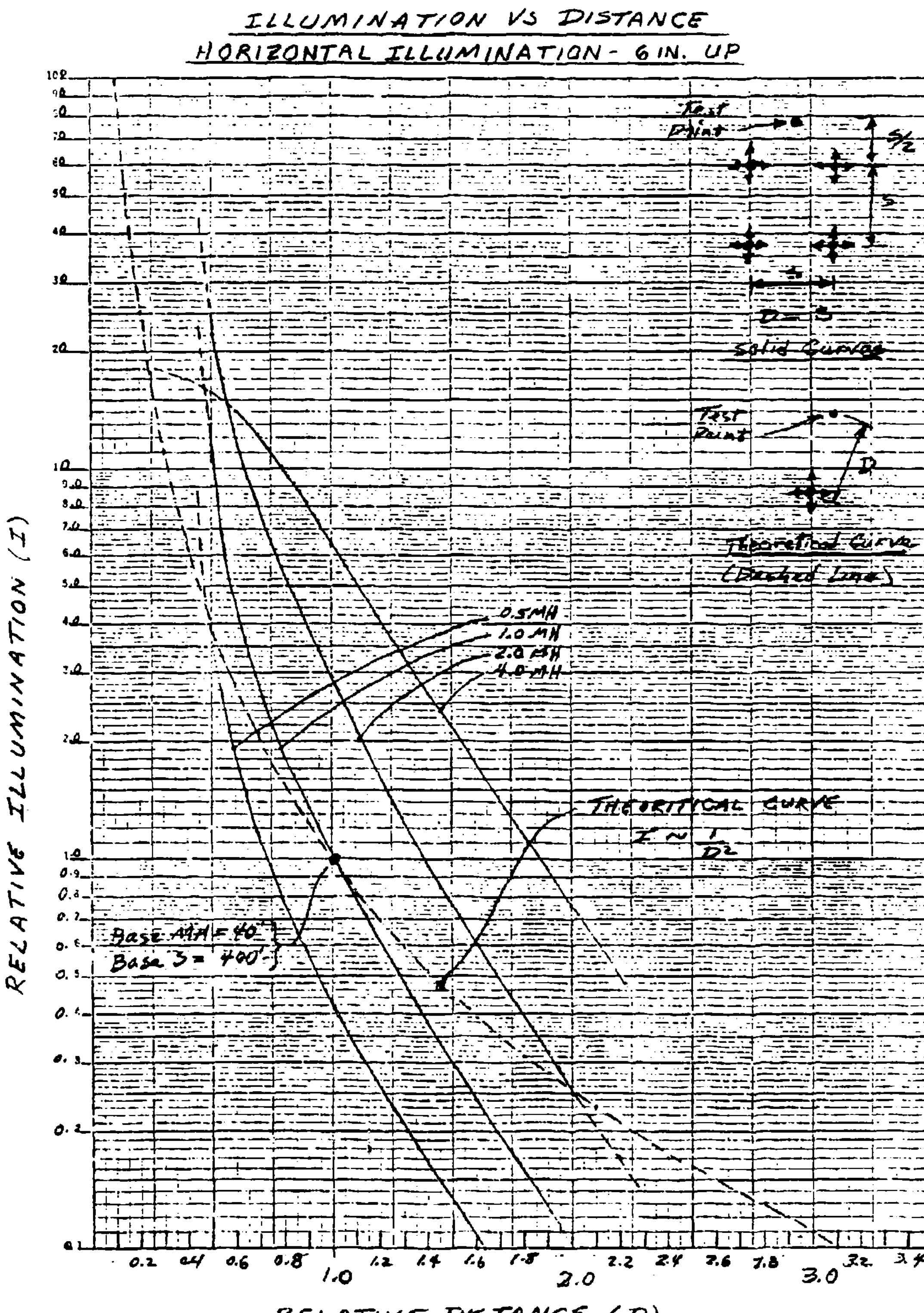


FIGURE 19
Sheet 2 of 2

5-8 Computer Format. The computerized lighting analysis performed for this study was based on point by point formulas similar to the format shown in Figure 10. Each lighting arrangement evaluated required entry of input data pertaining to the type, location, and quantity of luminaires to be used, the component of illumination to be calculated, and the configuration and location of the illumination grid to be printed out. An input sheet for the approved taxiway lighting configuration is examined on Sheet 3 of Figure 20. Sheets 1 and 2 list the steps involved in the computer calculation process. A printout of the complete program can be found in Appendix A, Attachment 13. To calculate the illumination at each point on the grid the contribution from each source has to be determined, resolved into components, and added to the subtotal. The most complex phase of this process involves determination of the light intensity applicable to each contribution. The appropriate pair of candlepower angles must be determined in each case by a technique employing direction cosines (Note Figure 21 and 22). As can be seen from Figure 22, the angles required and thus the value of intensity (candlepower) will be dependent on the type and orientation of the programmed luminaire. Candlepower data for a particular luminaire must first be entered and placed in storage. The computer will then copy the data into its memory whenever it is processing a trial in which that luminaire has been specified. The reference coordinate formats applicable for entering data are shown in Figure 23 for typical luminaires. A common format has been applied to both the horizontal polar axis and the vertical polar axis form of test data. The industry in contrast uses a distinct format for each of the two tests. The corresponding industry notation equivalent to the Corps of Engineers format is identified in the figure. Figure 23 also identifies the reference coordinates utilized when entering luminaire orientations. Appendix B contains a listing of all luminaires filed in computer storage to date, both by the computer identification code and by category. A copy of the actual candlepower data applicable to each luminaire is included. Because of the interpolation technique used, it is necessary that values be entered at the extreme candlepower angles for the vertical polar axis luminaires. This means that values at 0° and 360° horizontal have to be listed or that the entries at locations such as 355° and 5° have to be duplicated at -5° and 365°. The latter approach was usually taken for the luminaires listed in Appendix B. It is also necessary to enter a value at 90° vertical. Since this location corresponds to the polar region of the candlepower web, with the test procedure converging to a point, the value will be the same, or very nearly so, at all angular coordinates of 90° vertical from 0° horizontal to 90° horizontal.

SUMMARY OF PROCEDURE*

Step 1. The user enters input data. The luminaire identification code plus variables pertaining to location and orientation must be typed in per Section 2 on Sheet 3. One line of data must be entered for each luminaire used. The grid parameters selected for the illumination calculations must be entered per Section 3. Other input is noted in Section 1.

Step 2. The computer determines the location of the first point in the grid per the boundaries and increments specified in Step 1.

Step 3. Using direction cosines, the horizontal and vertical candlepower angles applicable to the specific point are computed for the first luminaire listed. The computer will select either a horizontal polar axis calculation format or a vertical polar axis format (See Figure 11) per the "H" or "V" code applicable to the particular luminaire.

Step 4. The computer then searches the candlepower table for the nearest listed angle above the horizontal angle determined in Step 3 and the nearest listed angle below. The two nearest spanning angles corresponding to the vertical angle of Step 3 are also located as a part of the same process.

Step 5. Applying an interpolation process to the four candlepower values of the Step 4 angles, the computer determines a relatively accurate approximation of the light intensity directed at the point.

Step 6. Direct illumination is calculated using the value of candlepower obtained in Step 5 and the luminaire parameters entered in Step 1. The direct value is resolved into either a horizontal foot-candle component or an X or Y vertical FC component per the instructions entered in Step 1 for the first grid.

Step 7. The processes of Step 2 through Step 7 are repeated for the second luminaire and in turn for every luminaire that was entered in Step 1. The FC contribution from each liminaire is added to the value obtained in Step 6. The final result is placed in storage pending printout instructions.

Step 8. The procedure of Steps 2 through 8 is repeated for the second point on the grid and in turn for every other point in the grid. The process is initiated at the point having the lowest "X" and "Y" coordinates proceeding progressively to the point having the next highest value of "Y" coordinate. After the highest magnitude "Y"

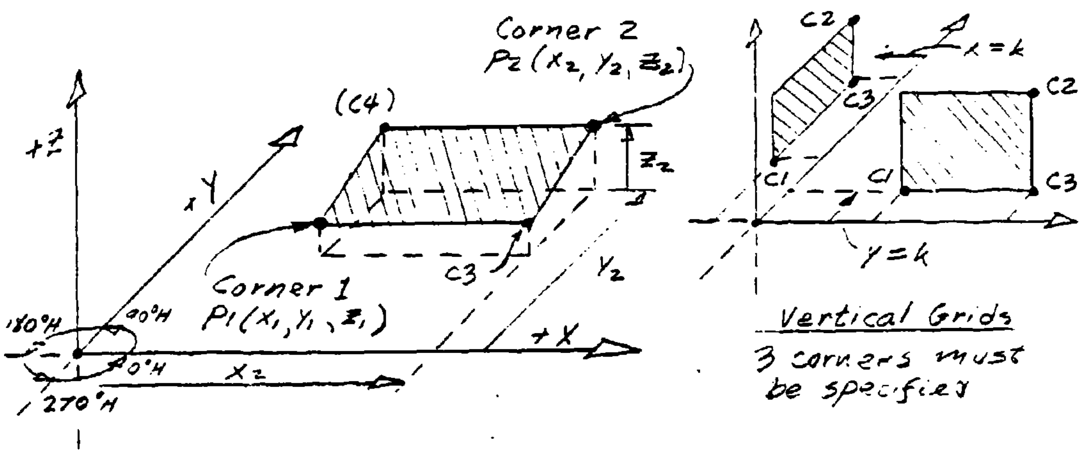
<u>COMPUTERIZED LIGHTING ANALYSIS</u>

Figure 20
Sheet 1 of 3

located has been processed, the calculation procedure shifts to the row having the second lowest "X" coordinate again proceeding from the point of lowest "Y" coordinate to the point of highest "Y" coordinate. Calculations are also made to determine the total footcandles on the grid, the average footcandles, and the uniformity ratio.

Step 9. The procedure of Steps 2-8 is repeated for the second grid and in turn for any other grids specified in Step 1.

*See Attachment 14 for a more detailed description of the computer analysis and the equipment used. A copy of the program itself constitutes Attachment 13.



ILLUMINATION GRID PARAMETERS
(Refer to Attach. 19 & 20 also)

NOTE: Corner 4 coordinates are computed automatically. For horizontal grids ($Z_1 = Z_2 = Z_3 = Z_4 = k$) only corners 1 and 2 need be entered, 3 and 4 will be calculated automatically.

COMPUTERIZED LIGHTING ANALYSIS

Figure 20
Sheet 2 of 3

INPUT LATA FORMAT
(See Layout on Fig 47)

1. GENERAL DATA - EXAMPLE AND KEY

(Line No)	(Switch#1)	(Switch#2)	(Switch#3)	(Switch#4)	(Switch#5)	(Switch#6)
00100	1	1				
00110	TW1BF	TAXI WAY GAP LIGHTING		061577		
(L.N.)	←(Test No)→	← Descriptive data - title, date, etc →				
00120	V250S3MGE1	0.85	0.80	1.00		
00130	H400HS44WE	0.85	0.85	1.00		
00140	9999999999					
(L.N.)	← (LC) →	← (LLD) →	← (DF) →	← (LF) →		

LC-Luminaire identif. code
LLD-Lamp lumen depreciation
DF-Dirt factor
LF-Misc. lamp factor

2. LUMINAIRE LOCATION AND ORIENTATION

00170	H400HS44WE	30.00	0.00	20.00	94.00	85.00	Pole #1
00180	V250S3MGE1	30.00	475.00	25.00	0.00	0.00	Pole #2
00190	H400HS44WE	30.00	475.00	20.00	280.00	85.00	
00200	H400HS44WE	30.00	475.00	20.00	256.00	85.00	
00210	9999999999						
(L.N.)	← (LC) →	←(X coord)→	←(Y coord)→	←(Z coord)→	← (HA) →	← (VA) →	

Note: HA = Horiz. aiming, VA = Vert. aiming. See Fig 23 for reference

3. GRID PARAMETERS (SEE SHEET 2)

00213	2	0.00	-20.00	.50	90.00	300.00	.50		
00214		10	17	H	0.00	0.00	0.00	0.00	(Z=k)
00260	5	0.00	40.00	3.00	60.00	220.00	3.00		
00270		7	10	V	270.00	0.00	0.00	0.00	(Z=k)
00340	9	0.00	240.00	0.00	90.00	240.00	50.00		
00350		10	11	V	270.00	90.00	240.00	0.00	(Y=k)
00360	10	30.00	0.00	0.00	30.00	240.00	50.00		
00370		13	11	V	270.00	30.00	240.00	0.00	(X=k)
00380		9999999999							
(L.N.)	(Grid#)	← (X, Y, Z coordinates of Corner #1) →			← (Coordinates of Corner #2) →				
(L.N.)		(No of col's)	(No of rows)	(FCs-H or V)	← (DR) →	← (Coordinates of Corner #3) →			

Note: DR = Direction of photometer readings-always 0° for horizontal grids.
For H grids, X increment = $(X_2-X_1) \div (NC-1)$; Y inc = $(Y_2-Y_1) \div (NR-1)$ = 20 ft for Grid 5.
For V grid with Y=k, NC is spec'd in x's, NR in z's; for V grid with X=k, NC is spec'd in y's, NR in z's. The "9999999999" digits signify the end of a routine.

CALCULATING CANDLEPOWER (CP) ANGLES USING DIRECTION COSINES

Given:

$X_L = X$ distance of luminaire from reference axes.
$Y_L = Y$ " " " " " "
$Z_L = Z$ " " " " " "

$X_P = X$ " " point (P_1) " " "
$Y_P = Y$ " " " " " "
$Z_P = Z$ " " " " " "

θ_A = Horizontal aiming angle of luminaire.
σ_{CA} = Vertical " " "

Find:

Vertical cp angle, θ_y - Vertical Polar Axis (VPA) test format.
Horizontal cp angle, Ψ_z - Vertical Polar Axis test format.
Vertical cp angle, σ_z - Horizontal Polar Axis (HPA) test format.
Horizontal cp angle Ψ_1 - Horizontal Polar Axis test format

Procedure:

$X_1 = X_{P1} - X_L$
$Y_1 = Y_{P1} - Y_L$
$Z_1 = Z_{P1} - Z_L$

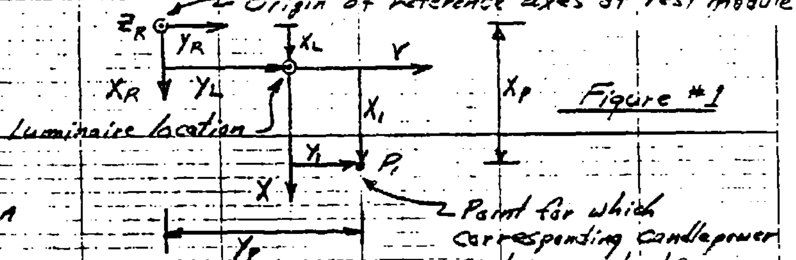


Figure #1

HPA: $\sigma_A = 90° - \sigma_{CA}$
VPA: $\sigma_A = \sigma_{CA}$

$$X' = X_1 \cos\alpha_1 + Y_1 \cos\beta_1 + Z_1 \cos\gamma_1$$
$$Y' = X_1 \cos\alpha_2 + Y_1 \cos\beta_2 + Z_1 \cos\gamma_2$$
$$Z' = X_1 \cos\alpha_3 + Y_1 \cos\beta_3 + Z_1 \cos\gamma_3$$

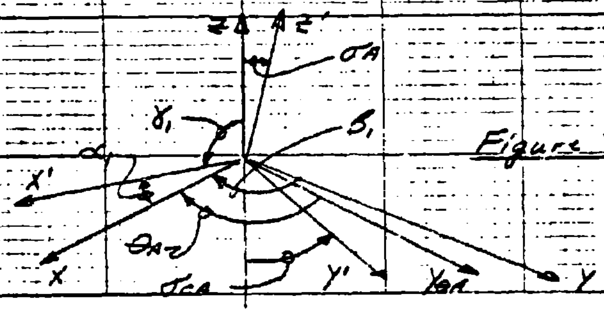


Figure #2

FIGURE 21
Sheet 1 of 4

$$\alpha_1 = \theta_A - 90^\circ$$
$$\beta_1 = \theta_A - 180^\circ$$
$$\gamma_1 = 90^\circ$$
$$X' = X_1 \cos(\theta_A - 90^\circ) + Y_1 \cos(\theta_A - 180^\circ) + Z_1 \cos(90^\circ)$$
$$\underline{X' = X_1 \cos(\theta_A - 90^\circ) + Y_1 \cos(\theta_A - 180^\circ)}$$

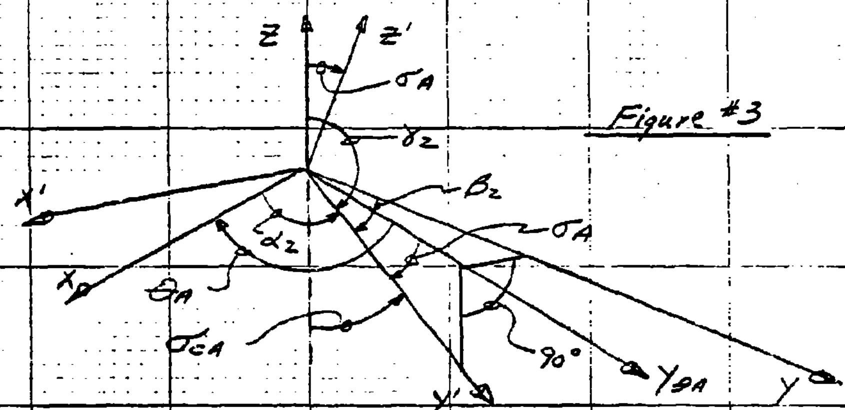


Figure #3

$$\alpha_2 = \arccos\left[\cos(\theta_A)\cos(\sigma_A)\right]$$
$$\beta_2 = \arccos\left[\cos(\theta_A - 90^\circ)\cos(\sigma_A)\right]$$
$$\gamma_2 = 90^\circ + \sigma_A$$
$$Y' = X_1 \cos(\theta_A)\cos(\sigma_A) + Y_1 \cos(\theta_A - 90^\circ)\cos(\sigma_A) + Z_1 \cos(90^\circ + \sigma_A)$$
$$\underline{Y' = X_1 \cos(\theta_A)\cos(\sigma_A) + Y_1 \cos(\theta_A - 90^\circ)\cos(\sigma_A) - Z_1 \sin(\sigma_A)}$$

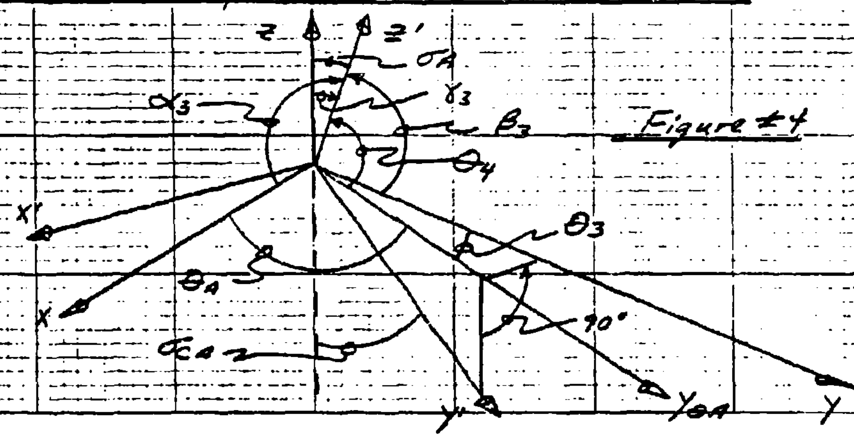


Figure #4

FIGURE 21
Sheet 2 of 4

$\theta_3 = \theta_A - 90°$ $\theta_4 = \sigma_A - 90°$

$\alpha_3 = \arccos[\cos(\theta_A)\cos(\theta_4)]$

$\alpha_3 = \arccos[\cos(\theta_A)\cos(\sigma_A - 90°)]$

$\beta_3 = \arccos[\cos(\theta_3)\cos(\theta_4)]$

$\beta_3 = \arccos[\cos(\theta_A - 90°)\cos(\sigma_A - 90°)]$

$\gamma_3 = \sigma_A$

$Z' = X_1\cos(\theta_A)\cos(\sigma_A - 90°) + Y_1\cos(\theta_A - 90°)\cos(\sigma_A - 90°) + Z_1\cos(\sigma_A)$

HPA FORMAT:

$\varphi_1 = \arccos\frac{X'}{D}$ (HCPL)

$\sigma_2 = \arctan\frac{Z'}{Y'}$ (VCPL)

(For 1st quadrant)

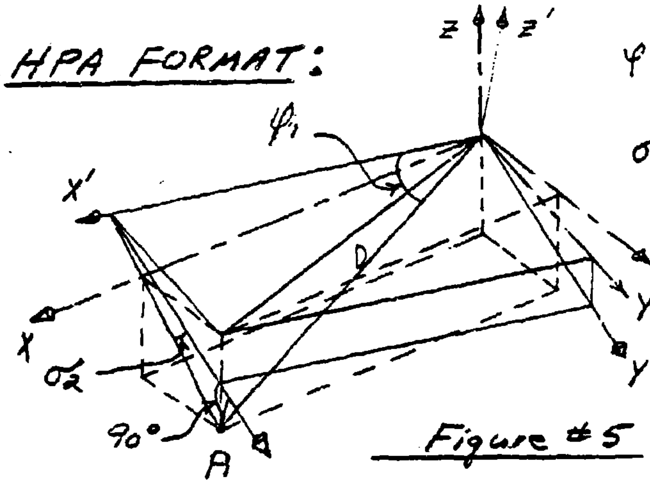


Figure #5

VPA FORMAT:

$\varphi_2 = \arctan\frac{Y'}{X'}$ (HCPL)

$\beta_4 = -\arcsin\frac{Z'}{D}$ (VCPL)

(For 1st quadrant)

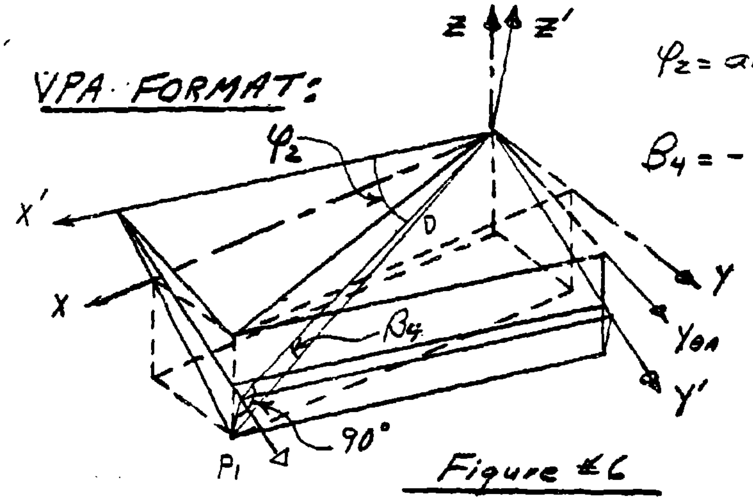


Figure #6

FIGURE 21
Sheet 3 of 4

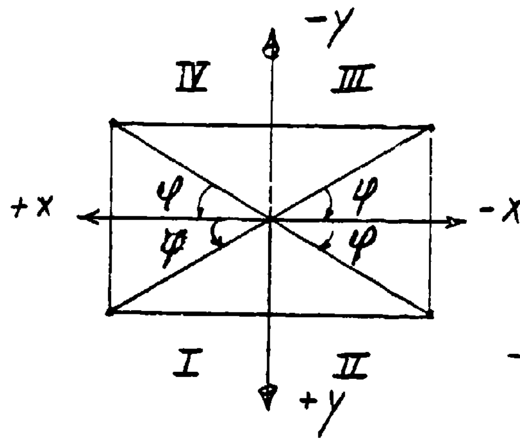


Figure #7

Quadrant

I : $X > 0 \quad Y > 0$

Horizontal Angle $= \underline{\underline{\varphi}}$

II : $X < 0 \quad Y > 0$

Horizontal Angle $= \underline{\underline{180° - \varphi}}$

III : $X < 0 \quad Y < 0$

Horizontal Angle $= \underline{\underline{180° + \varphi}}$

IV : $X > 0 \quad Y < 0$

Horizontal Angle $= \underline{\underline{360° - \varphi}}$

BASIC RELATIONSHIPS

$D = (X^2 + Y^2 + Z^2)^{1/2}$

Z = MH = mounting height

$\cos \gamma = \cos \sigma \cos \beta$

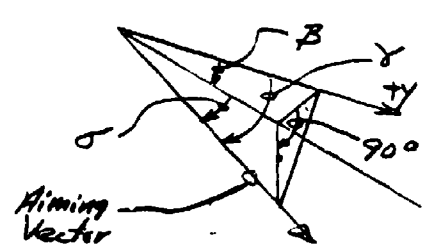
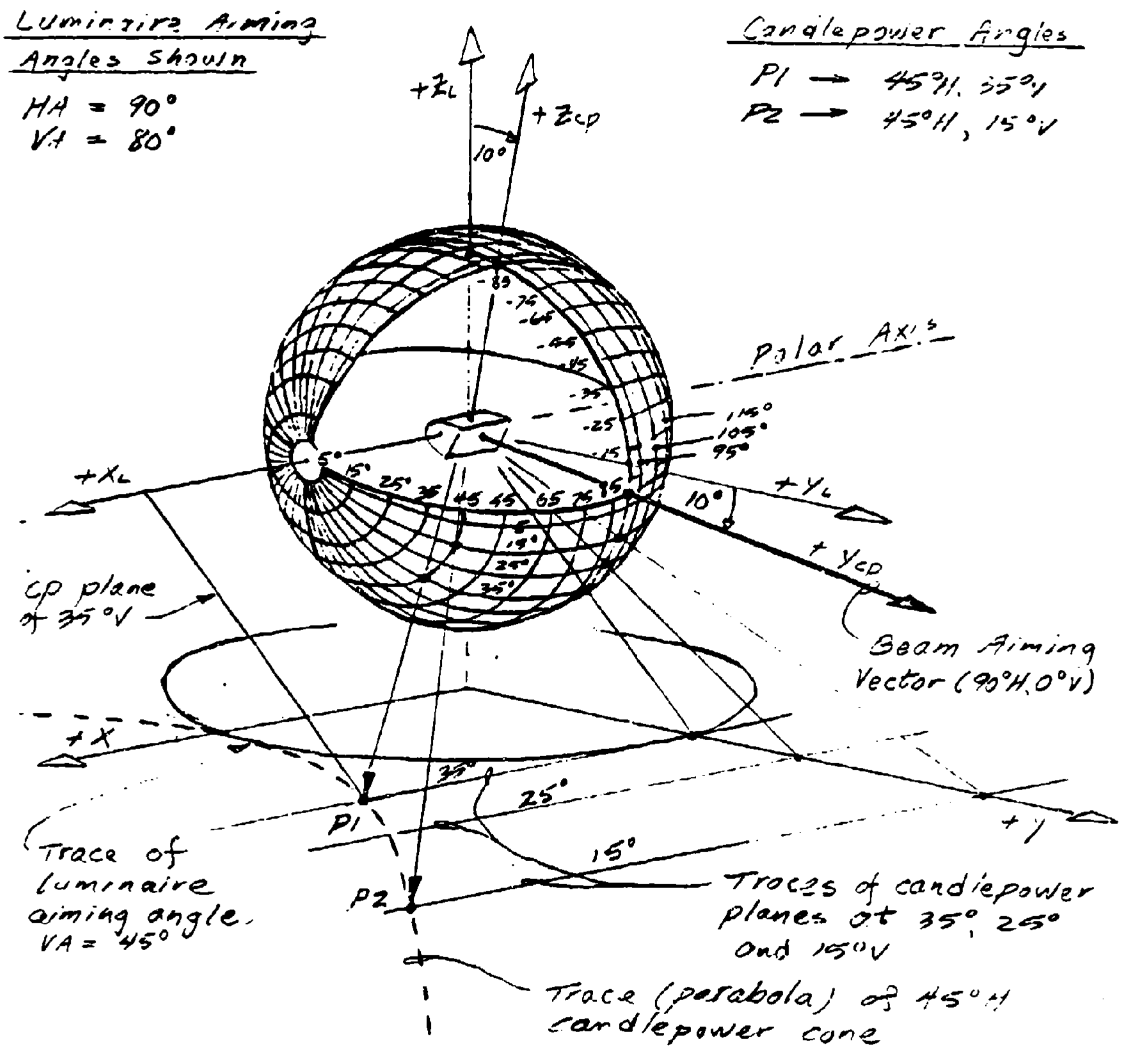


FIGURE 21
Sheet 4 of 4

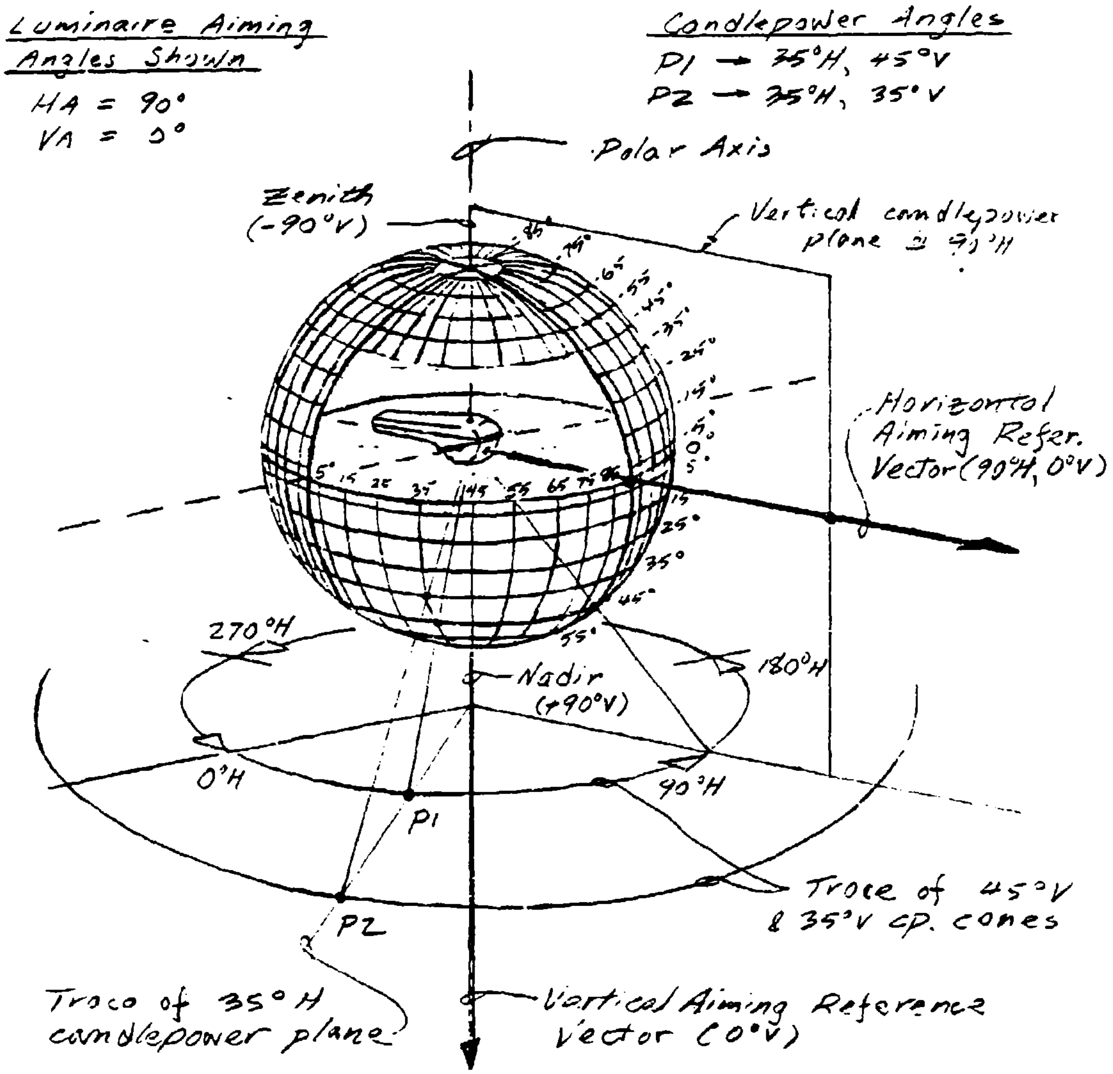
HORIZONTAL POLAR AXIS FORMAT



CANDLEPOWER ANGLE GEOMETRY

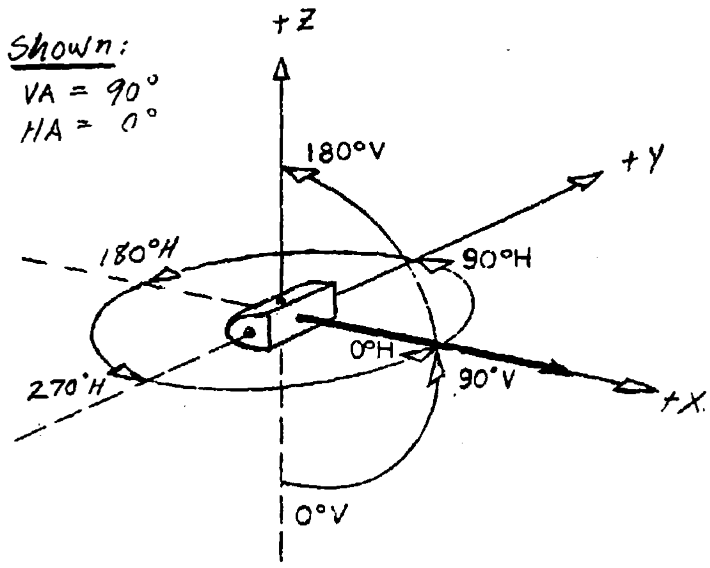
FIGURE 22
Sheet 1 of 2

VERTICAL POLAR AXIS FORMAT



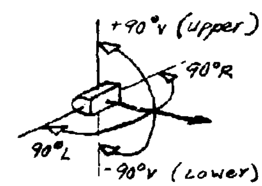
CANDLEPOWER ANGLE GEOMETRY

FIGURE 22
Sheet 2 of 2

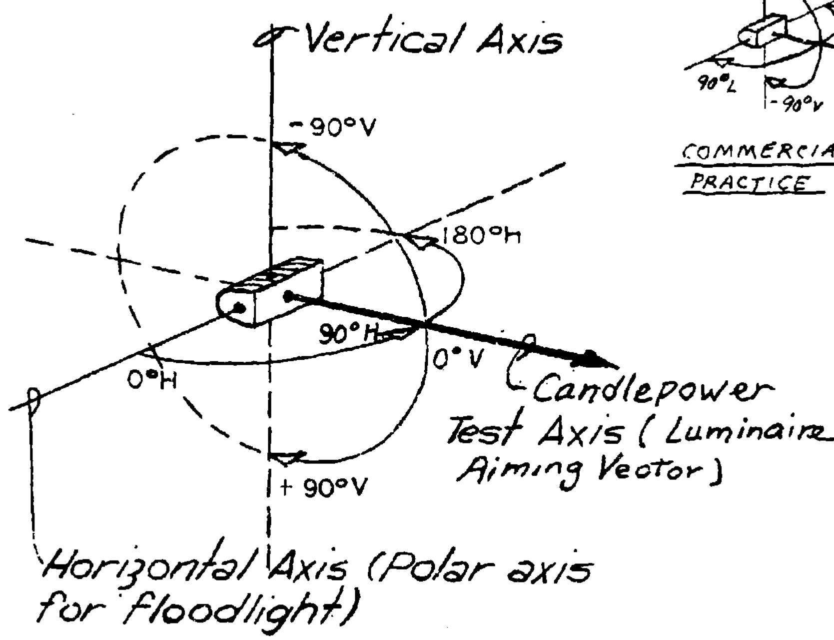


REFERENCE AXES FOR AIMING ANGLES

NO SCALE



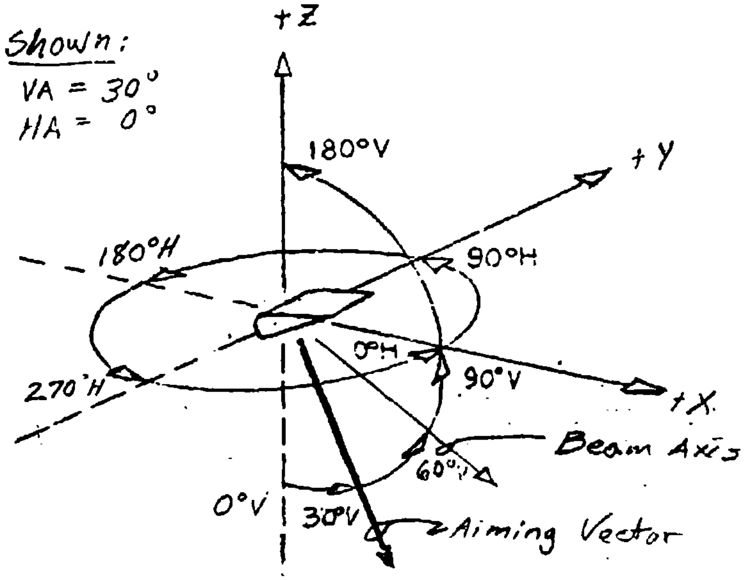
COMMERCIAL PRACTICE



REFERENCE AXES FOR CANDLE POWER DATA

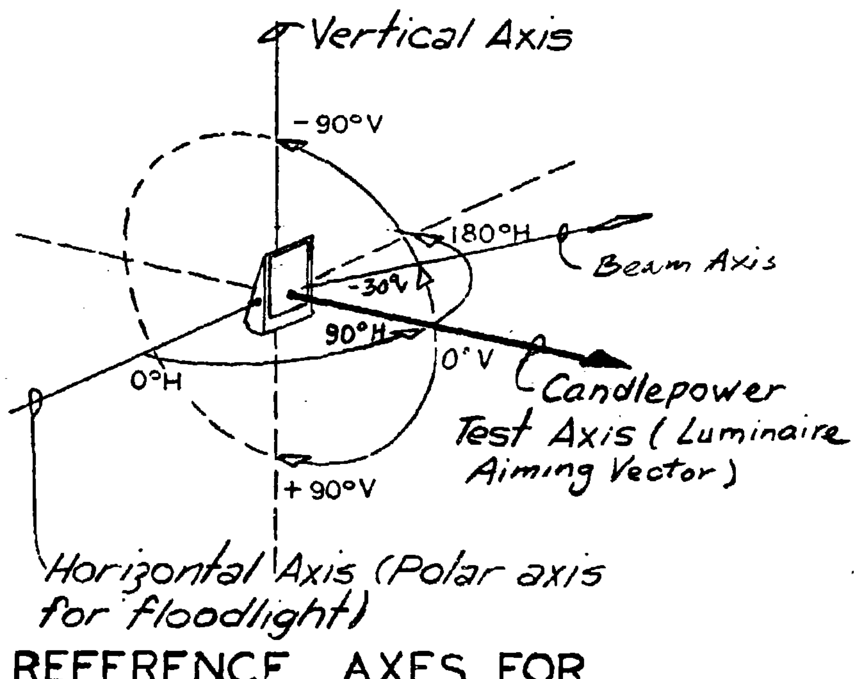
NO SCALE

FIGURE 23
Sheet 1 of 3



REFERENCE AXES FOR AIMING ANGLES

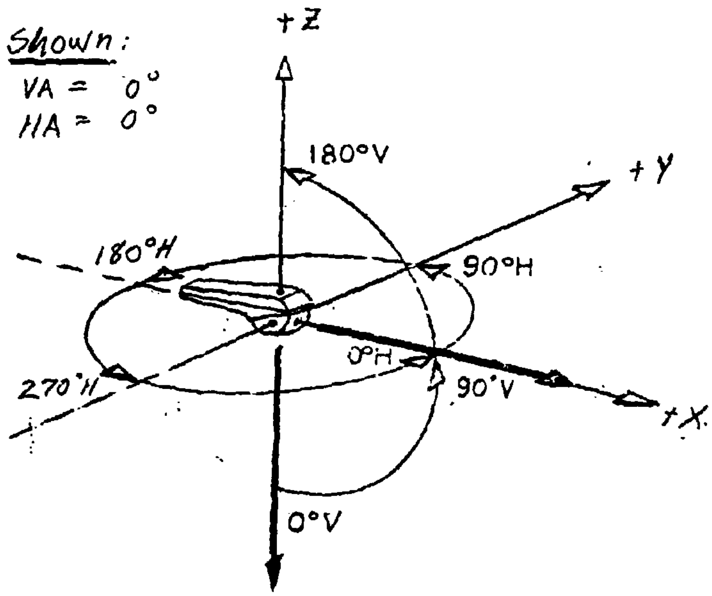
NO SCALE



REFERENCE AXES FOR CANDLE POWER DATA

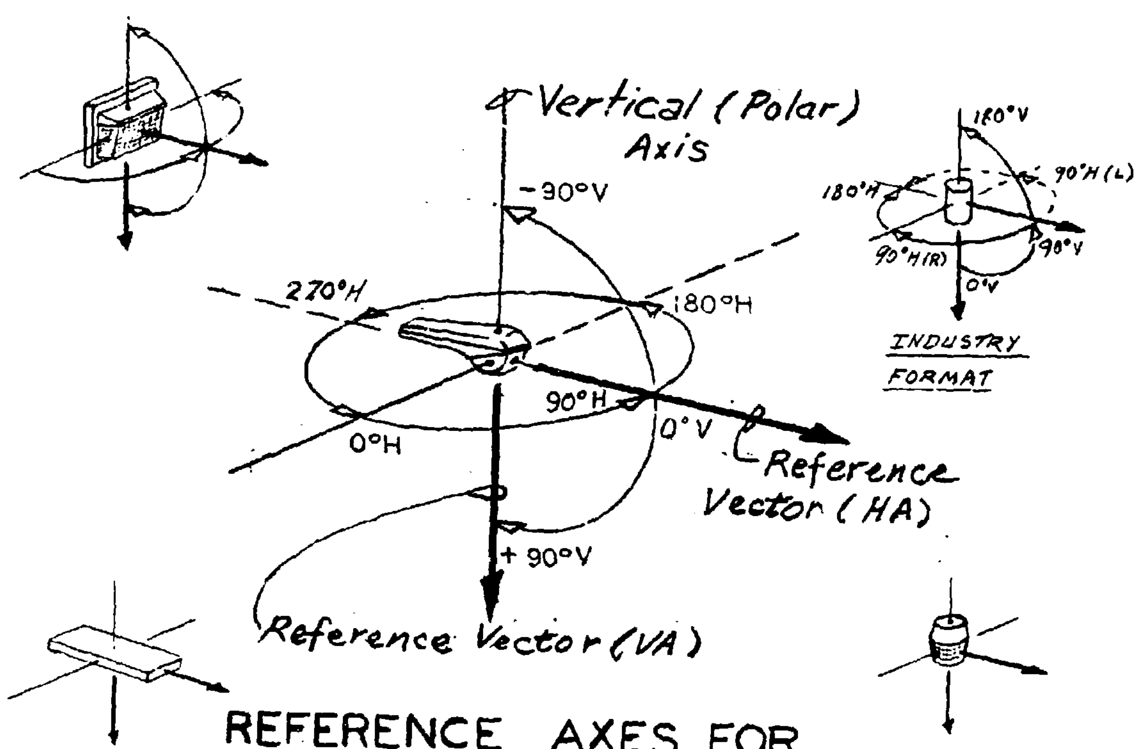
NO SCALE

FIGURE 23
Sheet 2 of 3



REFERENCE AXES FOR AIMING ANGLES

NO SCALE



REFERENCE AXES FOR CANDLE POWER DATA

NO SCALE

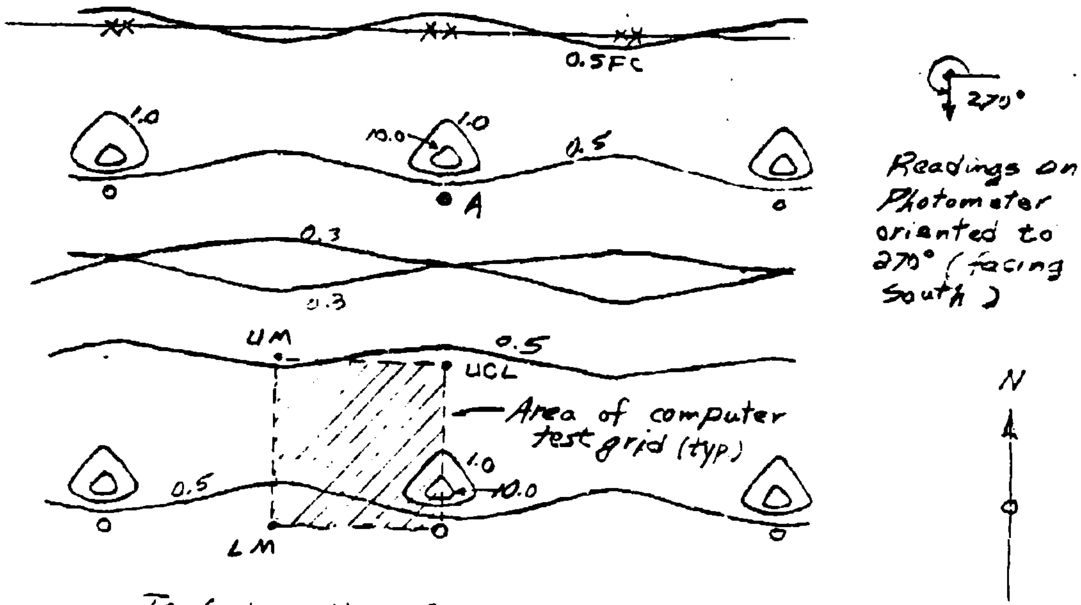
FIGURE 23
Sheet 3 of 3

5-9 The Modular Approach to Lighting Analysis. Computer aided evaluations of different lighting schemes, such as those examined in this study, can be performed using a modular approach.

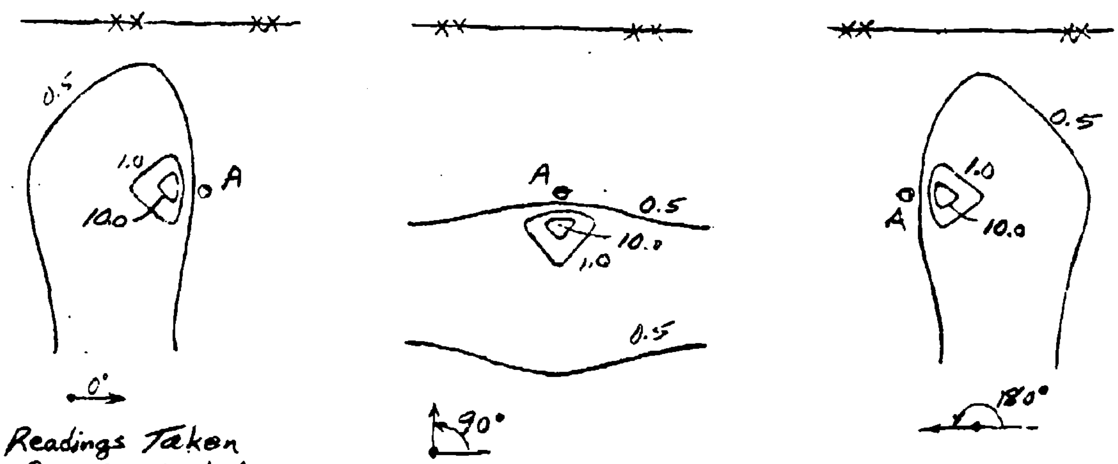
5-9.1. Single Row Format. In a pole line of infinite length, light distribution patterns around any one individual pole will be symmetrical and equal in magnitude to those around any other pole. Axes of symmetry will be the centerline at each pole (normal to the pole line) and the midline between any two poles. It is possible therefore to select one pair of poles and establish a test grid extending from one of the poles to the midline. Measurements can be taken within the test grid and if criteria minimums are satisfied for this grid, they will be met in all other grids. In performing a computer analysis a 6 pole module can be established with a test grid in the center. The critical points on the test grid are the upper midpoint (UM), the lower midpoint (LM), the upper centerline (UCL), and the pole. The upper midpoint is the weakest grid point for most configurations, the area under the pole usually will be comparatively strong. The 6 pole module approximates the infinite row configuration with sufficient accuracy for practically all applications. The additional contribution from an 8 pole module could add 1-2% to the illumination at the midpoint depending on the mounting weight, pole spacing, etc. For all practical purposes the characteristics of the 6 pole module are repeatable. It can be used, in building block style, to assemble a row of any length desired. Since essentially only one pole contributes to the illumination at the midpoint at the ends of a row, supplemental luminaires may be required unless there is an adjacent lighting sector that can contribute (Note discussion in Section 9-2 and Figure 36).

5-9.2. Area Lighting. For general area lighting an approach similar to the single row format can be employed. Assuming luminaires, in multiples of four, are equally spaced around a pole, the illumination patterns will be symmetrical in four directions. For vertical footcandle formats the distribution pattern will be directional (See Figure 24 for illustration). For a vertical footcandle format, the weakest point in the lighting module will be the upper midpoint of the test grid located at the center of the module. Changing module size from 4, to 6 or 8, to 9, and to 12 or 16 poles will have definite effects on the illumination at this point. Increasing the size beyond 16 poles will have minor effect on weak point illumination. A 12 pole module can be used, in building block style, to form an area of any size. Distribution patterns are symmetrical in all test grids, but those just inside the outside rows or columns will be slightly smaller in magnitude. The upper midpoints at the four corners will require supplementation (See Figure 37 for examples). The above relationships are valid for a vertical footcandle basis. If illumination were horizontally based, the weakest grids would be on the outside, the strongest grid would be the center one.

5-9.3. Evaluation of Data. An extensive number of computer trials were performed in the course of this study. Nearly all of the trials used in making comparative analysis utilized a 6 pole module if for a single row application and a 12 pole module for general area lighting. The three critical points (UM,LM,UCL) of the test grids were checked for adherence to criteria. Grids were computed in two formats - one, corresponding to the exact borders of the test grid, was utilized to determine the applicable uniformity ratio, for the second, an augmented version of the test grid, the printout data extended slightly beyond the test grid so that symmetry could be checked. The test grids, having relatively small increments between rows or columns of illumination points, served to delineate the isofootcandle patterns (see Figures 24, 25, & 26) characteristic of the particular configurations. A grid which encompased the entire module was also included in many trials. The row and column intervals in this instance were selected to correspond to the pole and critical point locations, or multiples thereof.



Isofootcandle Curves - Readings Looking South



Readings Taken for 0° orientation of photometer (looking East)

Readings Taken Looking North (90°)

Photometer oriented at 180° (Facing West)

ISOFOOTCANDLE CURVES - VERTICAL FC BASIS
(Assuming Symmetrical Pole & Luminaire Layout)

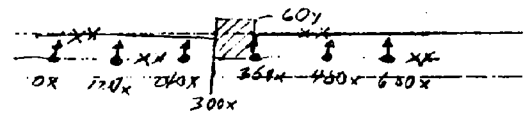
FIGURE 24

6. <u>FOOTCANDLE PRINTOUTS OF TYPICAL ARRANGEMENTS</u>. The methodology of the computerized calculations and format for entering input data were outlined in Fig. 20 and discussed in Section 5-8. The results of such calculations have been printed out in the form of illumination grids, such as shown in Figures 25 and 26. Figure 25 is an example of a perimeter lighting configuration. Each location on the grid can be identified in terms of a "X" and "Y" coordinate. The height of the grid plane in relation to ground level is defined by the "Z" coordinate. The figures at each point represent horizontal footcandles, maintained. Figure 26 provides an example of an area lighting printout. Each grid point represents vertical footcandles, maintained, for a 270° measurement basis. For convenience and consistency, the decimal point of each footcandle figure was selected as reference for spotting poles, delineating grids, and evaluating compliance with criteria.

T74A   PER LTG--- 6-POLE) 1X400HPS SP120 MH35 -- (020678   78/02/06 09.18.01 PAGE 17

TEST GRID 4			
COORDINATES OF CORNER 1	280.00	-25.00	.50
COORDINATES OF CORNER 2	370.00	110.00	.50
COORDINATES OF CORNER 3	370.00	-25.00	.50
COORDINATES OF CORNER 4	280.00	110.00	.50

Input Watts = 480 ea
4KW/100LF



	X 280.00	X 290.00	X 300.00	X 310.00	X 320.00	X 330.00	X 340.00	X 350.00	X 360.00	X 370.00	
Y 30.00	2.0003	1.81[illegible]	1.8037	1.8135	2.0003	2.3575	3.2409	4.1685	4.3074	4.1685	30.00 Y
Z .50											.50 Z
Y 25.00	1.9993	1.7745	1.7670	1.7745	1.9993	2.5286	3.3823	4.5376	4.8974	4.5375	25.00 Y
Z .50											.50 Z
Y 20.00	1.8879	1.6733	1.6431	1.6733	1.8879	2.5426	3.3063	4.6483	5.2337	4.6482	20.00 Y
Z .50											.50 Z
Y 15.00	1.7662	1.5205	1.4861	1.5205	1.7662	2.3443	3.2658	4.2983	5.2777	4.2982	15.00 Y
Z .50											.50 Z
Y 10.00	1.6353	1.3602	1.3028	1.3602	1.6353	2.1769	3.0600	4.0160	5.0418	4.0159	10.00 Y
Z .50											.50 Z
Y 5.00	1.5063	1.2111	1.1213	1.2042	1.4997	1.9673	2.5087	3.5251	4.5125	3.5250	5.00 Y
Z .50											.50 Z
Y 0.00	1.3662	1.0827	[illegible]	1.0827	1.3662	1.7580	2.0431	2.4735	[illegible]9760	2.4734	0.00 Y
Z .50											.50 Z
Y -5.00	1.1877	.9301	.7940	.9301	1.1877	1.5574	1.8686	2.1248	2.3026	2.1247	-5.00 Y
Z .50											.50 Z
Y -10.00	1.0039	.7962	.7167	.7962	1.0039	1.3354	1.6019	1.8333	1.8664	1.8332	-10.00 Y
Z .50											.50 Z
Y -15.00	.8562	.6547	.6228	.6687	.8562	1.1341	1.3283	1.4628	1.5294	1.4627	-15.00 Y
Z .50											.50 Z
Y -20.00	.7080	.5529	.5149	.5529	.7080	.8910	1.0487	1.1641	1.2045	1.1640	-20.00 Y
Z .50											.50 Z
Y -25.00	.5560	.4498	.4154	.4488	.5560	.6746	.7982	.9004	.9308	.9004	-25.00 Y
Z .50											.50 Z

TEST GRID

2.0 FC

1.0 FC

For 60 ft test grid: Avg. FC = 2.29 (3.36 Initial), Uniformity Ratio = 2.37
30 ft test grid: Avg. FC = 2.63 (3.47 Initial), Uniformity Ratio = 2.72
All values shown are horizontal footcandles, maintained, at 6 in. up
A maintenance factor of 0.68 was used (LLD = 0.85 x DF = 0.80)

FOOTCANDLE PRINTOUT

PERIMETER LIGHTING - DOUBLE FENCE

(See Attach 19 for complete run)

FIGURE 25
Sheet 1 of 2

[T74A]   PER LTG--PF(6-POLE) 1X400HPS SP120 MH35 -- 1020678   78/02/06 09.18.01 PAGE 16

TEST GRID 4   COORDINATES OF CORNER 1   240.00   -25.00   .50
COORDINATES OF CORNER 2   370.00   110.00   .50
COORDINATES OF CORNER 3   370.00   -25.00   .50
COORDINATES OF CORNER 4   240.00   110.00   .50

400w Roadway Luminaire
Type IV, medium, noncutoff
Westinghouse Cat #V2G-SPGD-FEA
Photometric Test # 672241
Socket Position # M-A

	X 240.00	X 290.00	X 300.00	X 310.00	X 320.00	X 330.00	X 340.00	X 350.00	X 360.00	X 370.00	
Y 110.00 Z .50	.2296	.2175	.2174	.2175	.2296	.2394	.2505	.2591	.2637	.2588	110.00 Y .50 Z
Y 105.00 Z .50	.2620	.2474	.2483	.2474	.2620	.2768	.2891	.3023	.3076	.3020	105.00 Y .50 Z
Y 100.00 Z .50	.2995	.2827	.2835	.2827	.2995	.3151	.3344	.3548	.3609	.3546	100.00 Y .50 Z
Y 95.00 Z .50	.3410	.3266	.3234	.3266	.3410	.3605	.3904	.4187	.4259	.4185	95.00 Y .50 Z
Y 90.00 Z .50	.3916	.3793	.3684	.3793	.3916	.4142	.4581	.5048	.5186	.5046	90.00 Y .50 Z
Y 85.00 Z .50	.4534	.4422	.4215	.4422	.4534	.4905	.5426	.6059	.6359	.6057	85.00 Y .50 Z
Y 80.00 Z .50	.5302	.5169	.5063	.5169	.5302	.5793	.6424	.7323	.7643	.7321	80.00 Y .50 Z
Y 75.00 Z .50	.6325	.6068	.6151	.6068	.6325	.6825	.7514	.8841	.9261	.8839	75.00 Y .50 Z
Y 70.00 Z .50	.7470	.7204	.7432	.7204	.7470	.8021	.8955	1.0573	1.1153	1.0572	70.00 Y .50 Z
Y 65.00 Z .50	.8749	.8689	.8836	.8689	.8749	.9459	1.0728	1.2728	1.3552	1.2727	65.00 Y .50 Z
Y 60.00 Z .50	1.0237	1.0211	$\boxed{1.0377}$	1.0211	1.0237	1.1203	1.2870	1.5459	$\boxed{1.6722}$	1.5457	60.00 Y .50 Z
Y 55.00 Z .50	1.2037	1.1814	1.1968	1.1814	1.2037	1.3205	1.5521	1.8474	2.0314	1.8472	55.00 Y .50 Z
Y 50.00 Z .50	1.3913	1.3607	1.3494	1.3607	1.3913	1.5583	1.8786	2.2230	2.4148	2.2229	50.00 Y .50 Z
Y 45.00 Z .50	1.5718	1.5190	1.5095	1.5190	1.5716	1.8314	2.3020	2.5968	2.7905	2.5967	45.00 Y .50 Z
Y 40.00 Z .50	1.7425	1.6668	1.6495	1.6668	1.7425	2.0928	2.6124	3.0298	3.2197	3.0297	40.00 Y .50 Z
Y 35.00 Z .50	1.9021	1.7973	1.7342	1.7973	1.9021	2.2407	2.9361	3.6046	3.7486	3.6045	35.00 Y .50 Z

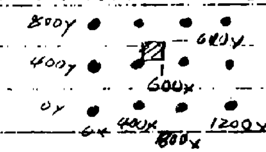
1.0 FC

TEST GRID

2.0 FC

FIGURE 25
Sheet 2 of 2

TE3029   AL:MR(12-POLE) (END ADJ+4L) HX1500Q S400 MH40 - (78/02/17 09.09.08 PAGE 24



TEST GRID 6   COORDINATES OF CORNER 1   400.00   400.00   3.00
48AW+ver 147A   COORDINATES OF CORNER 2   600.00   600.00   3.00
→ 3.27 KW/A   COORDINATES OF CORNER 3   600.00   400.00   3.00
COORDINATES OF CORNER 4   400.00   600.00   3.00

		X 400.00	X 425.00	X 450.00	X 475.00	X 500.00	X 525.00	X 550.00	X 575.00	X 600.00	X 0.00		
Y 600.00	Z 3.00	$\boxed{.5906}$ UGL	.6012	.5885	.5691	.5268	.4939	.4556	.4280	$\boxed{.4154}$ UM	0.0000	0.00 Y	0.00 Z
Y 580.00	Z 3.00	.7207	.7342	.7133	.6645	.6062	.5406	.4868	.4511	.4423	0.0000	0.00 Y	0.00 Z
Y 560.00	Z 3.00	.9169	.9284	.8913	.7899	.6925	.5967	.5164	.4771	.4691	0.0000	0.00 Y	0.00 Z
Y 540.00	Z 3.00	1.2033	1.2246	1.1497	.9743	.8023	.6474	.5478	.5034	.4826	0.0000	0.00 Y	0.00 Z
Y 520.00	Z 3.00	1.7107	1.7120	1.5563	1.2190	.9229	.7076	.5810	.5052	.4911	0.0000	0.00 Y	0.00 Z
Y 500.00	Z 3.00	2.6392	2.5754	2.1640	1.5572	1.0654	.7642	.5832	.5013	.4735	0.0000	0.00 Y	0.00 Z
Y 480.00	Z 3.00	4.4092	4.0442	3.0307	1.8890	1.1862	.7805	.5670	.4737	.4457	0.0000	0.00 Y	0.00 Z
Y 460.00	Z 3.00	6.6269	5.7370	3.8886	2.2275	1.2310	.7353	.5195	.4218	.3922	0.0000	0.00 Y	0.00 Z
Y 440.00	Z 3.00	6.7975	5.9405	4.1240	2.1137	1.0534	.6091	.4257	.3457	.3240	0.0000	0.00 Y	0.00 Z
Y 420.00	Z 3.00	3.2266	3.8826	2.7222	1.3705	.6591	.3998	.3011	.2585	.2466	0.0000	0.00 Y	0.00 Z
Y 400.00	Z 3.00	.1558	.1599	.1622	.1653	.1661	.1676	.1690	.1688	$\boxed{.1677}$ LM	0.0000	0.00 Y	0.00 Z

VFC 270° ⇓

1.0 FC

0.47 FC

Luminaire = 1500W quartz floodlight, Gen. Elect. Cat # C525G006
Photometric Test # 55-175785

FOOTCANDLE PRINTOUT OF TEST GRID
AREA LIGHTING-MULTIROW
(see Attach 20 for complete run)

64

FIGURE 26

7. ECONOMIC ANALYSIS OF PERIMETER LIGHTING FORMATS.

7-1 General. The approach to perimeter lighting used in 1975 prior to surveillance TV considerations, was based on glare projection toward the intruder. The floodlight type of luminaire was most compatible to that type of lighting philosophy. An extensive number of trial lighting configurations using floodlights were formulated and evaluated with the aid of the computer in 1975. Those configurations that satisfied photometric criteria were then analyzed economically, both individually and on a comparative basis, using a separate computer program. Results are discussed in Section 8. (Note: The lighting program used for these 1975 computer trials utilized a partially inaccurate technique for determining candlepower angles. The error would affect portions of the footcandle grids and this could change the total costs of individual schemes somewhat. However the adjustment would be proportionate in each case and could not affect the relative standing of any one scheme in the overall ecomomic comparison).

7-2 Factors Evaluated. All significant factors bearing on cost were considered both initial (materials and installation and annual (operating, maintenance and annual ownership). A 10 year life was assumed. These factors are described in the following paragraphs.

7-2.1. Initial Equipment Investment includes costs for luminaires, lamps, ballasts, poles and foundations and accessories, electrical distribution including controls, standby generators, and UPS (uninterruptible power supply) for some High and Low Pressure Sodium lighting arrangements.

Wood poles were selected for cost comparisons due to their relatively low cost. See Table IV for cost analysis (1975 figures).

TABLE IV
POLE SELECTION - 30' HIGH

Description	Alum.	Pt'd Steel	Gal'd Stl	Wood
Pole	473	312	332	70
Brackets	40	32	40	--
Crossarm & Brace	--	--	--	25
Foundation	50	50	50	--
Erection, Pole Luminaire	120	120	120	120
Painting	--	20	--	--
	683	534	542	215
Overhead & Profit	X1.3	X 1.3	X1.3	X1.3
	$888	$694	$704	$280

TABLE V
COST COMPARISON OF OVERHEAD PRIMARY ELECTRICAL VS UNDERGROUND PRIMARY ELECTRICAL

Based on 80 acre site with one mile of Electrical Distribution and two 300 KVA 3Ø transformers. (1975 figures)

Item	Unit Cost	Quantity Cost	Total Site Cost
Overhead System			
Overhead Primary electrical Distribution 4 #4/0 ACSR	$7.95/LF	$41,980	
3-100 KVA Pole Mtd Transformers	$4,200/Ea	$ 8,400	$50,380
Underground System			
Underground Primary Electrical Distribution 15KV, 3 #2 Copper with 1#2, 600 Volt Copper, Concrete Encased	$17.50/LF	$92,400	
300 KVA Pad Mtd Transformer With Hardening	$7,500/Ea	$15,000	$107,400

Underground primary and secondary distribution system was selected for security reasons. See Table V for relative costs of overhead and underground distribution. (Note: This analysis is based on secondary distribution in conduit. Subsequently it was decided that a direct burial cable system would be acceptable in lieu of the secondary duct system.) Distribution from point of automatic transfer is either underground or hardened.

Standby generators are sized to carry total connected load. In combination schemes with quartz and sodium, generators must be large enough to supply energy to both light sources during restrike period.

UPS system costs includes 15 minute battery backup and will supply power during standby generator startup period.

7-2.2. Initial Labor Estimates include contractor costs for installation of poles, luminaires, electrical distribution, generators, and UPS.

7-2.3. Illumination Calculations include pole spacing (ft.) and area (acres), maintenance factors used, design footcandles and unit cost per foot or acre. A utilization factor was not programmed in tests so is shown as 0.00.

7-2.4. Annual Cost include energy costs, generator fuel costs and replacement lamp costs. Also listed is total connected load and total KW/hr consumption per year.

7-2.5. Annual Maintenance includes costs for relamping, cleaning and general repair to all system components.

7-2.6. Annual Ownership and Operating Cost combines the initial cost on an annual basis with maintenance and operating costs. Also provided is a unit price per foot or acre.

7-3 Comparative Costs. Copies of the computer summary sheets have been provided to conveniently show relative costs between schemes (see Figure 27 or Appendix D, Sheets 1-6). They can be used to make the following pertinent comparison:

a. 100% quartz, single fence, schemes 1, 2, 3, 4, 5. Lowest relative cost is Scheme 1.

b. 100% H.P. sodium, single fence, schemes 6, 7, 8 and 9. Lowest relative cost is Scheme 8.

c. 100% L.P. sodium, single fence, schemes 10 through 17. Lowest relative cost is Scheme 10.

d. Single Fence. H.P. sodium without UPS (Scheme 18) versus L.P. sodium without UPS (Scheme 22) and 100% quartz (Scheme 1). Lowest relative cost is Scheme 22, low pressure sodium.

e. Single Fence. H.P. sodium with 100% quartz backup (Scheme 19), L.P. sodium with 100% quartz backup (Scheme 23) and 100% quartz (Scheme 1). Lowest relative cost is Scheme 19, high pressure sodium.

f. Schemes 26, 27, 28 compare 100% quartz, 100 HPS and 100% LPS with double fence layout. Lowest relative cost is Scheme 27, high pressure sodium.

7-4 Program Format. The summary sheet format shown in Figure 27 is a condensed version of the longer format used in the individual analysis (see Figure 29 for example). The key to the computer program used in the 1975 perimeter lighting analysis is shown in Figure 28. A modified version of this format is shown in Figure 30. This is a general format which could be used on any project. Figure 31 is a work sheet for use when entering data. Since the computer recognizes the input data only according to relative position, there must be an entry corresponding to each line, either in fractional or integer form. To instruct the computer to ignore a line item the user must enter "000".

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT — PAGE 51

ECONOMIC COMPARISION

SINGLE FENCE

	PERIMETER LIGHTING SCHEME 1 100% QUARTZ	PERIMETER LIGHTING SCHEME 2 100% QUARTZ	PERIMETER LIGHTING SCHEME 3 100% QUARTZ	PERIMETER LIGHTING SCHEME 4 100% QUARTZ	PERIMETER LIGHTING SCHEME 5 100% QUARTZ
I. INITIAL EQUIPMENT INVESTMENT					
1. QUANTITY OF LUMINAIRES	268	320	134	160	345
3. LUMINAIRE COST TOTAL	11256.00	17120.00	8710.00	10400.00	4485.00
4. QUANTITY OF POLES	134	160	67	160	115
9. POLE + FOUNDATION COST TOTAL	9380.00	11200.00	4690.00	11200.00	8050.00
14. ELECTRICAL DISTRIBUTION	26800.00	64000.00	40200.00	48600.00	34500.00
14A. STANDBY GENERATOR COST	22780.00	54400.00	34170.00	40800.00	29325.00
14C. UPS COST	0.00	0.00	0.00	0.00	0.00
16. TOTAL INIT EQUIP INCL LAMPS	73700.00	151200.00	89780.00	112800.00	80845.00
17. RELATIVE INIT EQUIP INVESTMENT	1.31	2.68	1.59	2.00	1.44
II. INITIAL LABOR ESTIMATES					
20. NET LABOR, POLES + LUMINAIRES	36850.00	46400.00	20435.00	34800.00	38525.00
21. LABOR ELECTRICAL DISTRIBUTION	20100.00	48000.00	30150.00	36000.00	25875.00
22. TOTAL INITIAL LABOR	59630.00	100800.00	54605.00	77600.00	67850.00
23. TOTAL INITIAL INVESTMENT	133330.00	252000.00	298785.00	344800.00	303095.00
24. RELATIVE INITIAL INVESTMENT	1.00	1.89	2.24	2.59	2.27
IV. ANNUAL COSTS					
31. TOTAL SYSTEM KW	134.	320.	201.	240.	173.
33. TOTAL ENERGY KWH/YEAR	536000.	1280000.	804000.	960000.	690000.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00	0.00	0.00
37. ANNUAL KWH COST	10720.00				
370. DIESEL FUEL COST	214.40	512.00	321.60	384.00	276.00
40. REPLACEMENT LAMP COST	10452.00	13440.00	6030.00	7200.00	13455.00
V. ANNUAL MAINTENANCE, LABOR + MATERIALS					
44. RELAMPING COST - LABOR	2680.00	3200.00	1340.00	1600.00	3450.00
47. CLEANING COST - LABOR	0.00	0.00	0.00	0.00	0.00
50. PAINTING COST - LABOR	0.00	0.00	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	702.16	1467.20	877.70	1104.00	763.60
52. TOTAL ANNUAL MAINTENANCE COST	3382.16	4667.20	2217.70	2704.00	4213.60
53. ANNUAL OPERATING COST	24768.56	44219.20	24649.30	29488.00	31744.60
VI. ANNUAL OWNERSHIP + OPERATING COST					
55. FIXED OWNERSHIP COST	18438.13	35147.84	20217.25	26696.00	20477.82
56. ANNUAL OWNERSHIP + OP'ING COST	43206.69	79367.04	44866.55	56184.00	52222.42
VII. RELATIVE COSTS OF LIGHT					
59. RELATIVE COST EXCLUDING FIXED	6.64	11.85	6.61	7.90	8.51
60. RELATIVE TOTAL COST	2.90	5.33	3.01	3.77	3.51

COMPARATIVE COSTS - PERIMETER LIGHTING

FIGURE 27
Sheet 1 of 6

ECONOMIC COMPARISION

SINGLE FENCE

	PERIMETER LIGHTING SCHEME 6 100% HP SODIUM	PERIMETER LIGHTING SCHEME 7 100% HP SODIUM	PERIMETER LIGHTING SCHEME 8 100% HP SODIUM	PERIMETER LIGHTING SCHEME 9 100% HP SODIUM	PERIMETER LIGHTING SCHEME 10 100% LP SODIUM
I. INITIAL EQUIPMENT INVESTMENT					
1. QUANTITY OF LUMINAIRES	200	134	134	100	160
3. LUMINAIRE COST TOTAL	78000.00	32160.00	32160.00	25000.00	43680.00
4. QUANTITY OF POLES	200	134	67	100	80
9. POLE + FOUNDATION COST TOTAL	88000.00	9380.00	4690.00	7000.00	5600.00
14. ELECTRICAL DISTRIBUTION	14500.00	9715.00	9715.00	11500.00	5600.00
14A. STANDBY GENERATOR COST	12325.00	8257.75	8257.75	9775.00	4760.00
14C. UPS COST	43500.00	29145.00	29145.00	34500.00	16800.00
16. TOTAL INIT EQUIP INCL LAMPS	243925.00	92677.75	89059.75	91675.00	79320.00
17. RELATIVE INIT EQUIP INVESTMENT	4.33	1.65	1.58	1.63	1.41
II. INITIAL LABOR ESTIMATES					
20. NET LABOR, POLES + LUMINAIRES	44400.00	28810.00	18425.00	23000.00	17200.00
21. LABOR ELECTRICAL DISTRIBUTION	10875.00	7286.25	7286.25	8625.00	4200.00
22. TOTAL INITIAL LABOR	62525.00	40953.75	30568.75	37375.00	24200.00
23. TOTAL INITIAL INVESTMENT	460950.00	288031.50	274028.50	283450.00	257920.00
24. RELATIVE INITIAL INVESTMENT	3.46	2.16	2.06	2.13	1.93
IV. ANNUAL COSTS					
31. TOTAL SYSTEM KW	73.	49.	49.	58.	28.
33. TOTAL ENERGY KWH/YEAR	290000.	194300.	194300.	230000.	112000.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00	0.00	0.00
37. ANNUAL KWH COST	5800.00				
370. DIESEL FUEL COST	116.00	77.72	77.72	92.00	44.80
40. REPLACEMENT LAMP COST	3840.00	2031.16	2572.80	1440.00	921.60
V. ANNUAL MAINTENANCE, LABOR + MATERIALS					
44. RELAMPING COST - LABOR	336.84	225.68	225.68	123.08	170.67
47. CLEANING COST - LABOR	231.58	155.16	155.16	138.46	234.67
50. PAINTING COST - LABOR	0.00	0.00	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	2363.25	886.58	839.68	877.75	764.40
52. TOTAL ANNUAL MAINTENANCE COST	2931.67	1267.42	1220.52	1139.29	1169.73
53. ANNUAL OPERATING COST	12687.67	7262.30	7757.04	7271.29	4376.13
VI. ANNUAL OWNERSHIP + OPERATING COST					
55. FIXED OWNERSHIP COST	42436.70	18404.83	16264.18	17771.30	14290.88
56. ANNUAL OWNERSHIP + OPMING COST	55124.37	25667.13	24021.22	25042.59	18667.01
VII. RELATIVE COSTS OF LIGHT					
59. RELATIVE COST EXCLUDING FIXED	3.40	1.95	2.08	1.95	1.17
60. RELATIVE TOTAL COST	[illegible]	1.72	1.61	1.68	1.25

FIGURE 27
SHEET 2 OF 5

ECONOMIC COMPARISION

SINGLE FENCE

	PERIMETER LIGHTING SCHEME 11 100% LP SODIUM	PERIMETER LIGHTING SCHEME 12 100% LP SODIUM	PERIMETER LIGHTING SCHEME 13 100% LP SODIUM	PERIMETER LIGHTING SCHEME 14 100% LP SODIUM	PERIMETER LIGHTING SCHEME 15 100% LP SODIUM
I. INITIAL EQUIPMENT INVESTMENT					
1. QUANTITY OF LUMINAIRES	160	134	134	134	201
3. LUMINAIRE COST TOTAL	49280.00	48240.00	45426.00	48240.00	50250.00
4. QUANTITY OF POLES	80	134	67	67	67
9. POLE + FOUNDATION COST TOTAL	5600.00	9380.00	4690.00	4690.00	8710.00
14. ELECTRICAL DISTRIBUTION	5600.00	8040.00	8040.00	9040.00	12060.00
14A. STANDBY GENERATOR COST	4760.00	6834.00	6834.00	6834.00	10251.00
14C. UPS COST	16800.00	24120.00	24120.00	24120.00	36180.00
16. TOTAL INIT EQUIP INCL LAMPS	84920.00	101036.00	93532.00	96346.00	124034.00
17. RELATIVE INIT EQUIP INVESTMENT	1.51	1.79	1.66	1.71	2.20
II. INITIAL LABOR ESTIMATES					
20. NET LABOR, POLES + LUMINAIRES	17200.00	30820.00	20435.00	20435.00	25929.00
21. LABOR ELECTRICAL DISTRIBUTION	4200.00	6030.00	6030.00	6030.00	9045.00
22. TOTAL INITIAL LABOR	24200.00	40870.00	30485.00	30485.00	41004.00
23. TOTAL INITIAL INVESTMENT	263520.00	296306.00	278417.00	281231.00	319488
24. RELATIVE INITIAL INVESTMENT	1.98	2.22	2.09	2.11	2
IV. ANNUAL COSTS					
31. TOTAL SYSTEM KW	28.	40.	40.	40.	60.
33. TOTAL ENERGY KWH/YEAR	112000.	160800.	160800.	160800.	241200.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00	0.00	0.00
37. ANNUAL KWH COST	2240.00				
370. DIESEL FUEL COST	44.80	64.32	64.32	64.32	96.48
40. REPLACEMENT LAMP COST	921.60	1415.04	1202.78	1415.04	2122.56
V. ANNUAL MAINTENANCE, LABOR + MATERIALS					
44. RELAMPING COST - LABOR	170.67	142.93	110.77	142.93	214.40
47. CLEANING COST - LABOR	234.67	196.53	196.53	196.53	294.80
50. PAINTING COST - LABOR	0.00	0.00	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	820.40	966.14	891.10	919.24	1174.51
52. TOTAL ANNUAL MAINTENANCE COST	1225.73	1305.61	1198.41	1258.71	1683.71
53. ANNUAL OPERATING COST	4432.13	6000.97	5681.51	5954.07	8726.75
VI. ANNUAL OWNERSHIP + OPERATING COST					
55. FIXED OWNERSHIP COST	15086.08	19522.73	16982.49	17382.08	22500.61
56. ANNUAL OWNERSHIP + OP"ING COST	19518.21	25523.69	22664.00	23336.14	31227.36
VII. RELATIVE COSTS OF LIGHT					
59. RELATIVE COST EXCLUDING FIXED	1.19	1.61	1.52	1.60	2.34
60. RELATIVE TOTAL COST	1.31	1.71	1.52	1.57	2.10

FIGURE 27
Sheet 3 of 6

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT ~~PAGE 54~~

ECONOMIC COMPARISION

SINGLE FENCE

	PERIMETER LIGHTING SCHEME 16 100% LP SODIUM	PERIMETER LIGHTING SCHEME 17 100% LP SODIUM	PERIMETER LIGHTING SCHEME 18 HP SODIUM W/O UPS	PERIMETER LIGHTING SCHEME 19 HP SODIUM + 100% Q	PERIMETER LIGHTING SCHEME 20 HPS + 75% Q
I. INITIAL EQUIPMENT INVESTMENT					
1. QUANTITY OF LUMINAIRES	115	140	134	268	268
3. LUMINAIRE COST TOTAL	28750.00	40000.00	32160.00	40370.00	40870.00
4. QUANTITY OF POLES	115	80	67	67	67
9. POLE + FOUNDATION COST TOTAL	8050.00	5600.00	4690.00	4690.00	4690.00
14. ELECTRICAL DISTRIBUTION	6900.00	9600.00	7772.00	47972.00	34572.00
14A. STANDBY GENERATOR COST	5865.00	8160.00	6606.20	40776.20	29386.20
14C. UPS COST	20700.00	28800.00	0.00	0.00	0.00
16. TOTAL INIT EQUIP INCL LAMPS	74360.00	97440.00	56320.20	141410.20	116496.20
17. RELATIVE INIT EQUIP INVESTMENT	1.31	1.73	1.00	2.51	2.07
II. INITIAL LABOR ESTIMATES					
20. NET LABOR, POLES + LUMINAIRES	26450.00	24400.00	18425.00	28475.00	28475.00
21. LABOR ELECTRICAL DISTRIBUTION	5175.00	7200.00	5829.00	35979.00	25929.00
22. TOTAL INITIAL LABOR	35075.00	36400.00	25031.20	69251.20	57861.20
23. TOTAL INITIAL INVESTMENT	263535.00	288240.00	235751.40	210661.40	174347.40
24. RELATIVE INITIAL INVESTMENT	1.98	2.16	1.77	1.58	1.31
IV. ANNUAL COSTS					
31. TOTAL SYSTEM KW	35.	48.	39.	240.	173.
33. TOTAL ENERGY KWH/YEAR	138000.	192000.	155440.	159460.	158120.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00	0.00	0.00
37. ANNUAL KWH COST	2760.00				
37D. DIESEL FUEL COST	55.20	76.80	62.18	383.78	276.58
40. REPLACEMENT LAMP COST	1214.40	1689.60	2572.80	2602.95	2600.94
V. ANNUAL MAINTENANCE, LABOR + MATERIALS					
44. RELAMPING COST - LABOR	122.67	170.67	225.68	232.38	232.38
47. CLEANING COST - LABOR	168.67	234.67	155.16	419.81	419.81
50. PAINTING COST - LABOR	0.00	0.00	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	702.65	921.60	512.28	1343.08	1095.18
52. TOTAL ANNUAL MAINTENANCE COST	993.99	1326.93	893.12	1995.27	1747.37
53. ANNUAL OPERATING COST	5023.58	6933.33	6636.90	8171.20	7733.69
VI. ANNUAL OWNERSHIP + OPERATING COST					
55. FIXED OWNERSHIP COST	14958.28	18255.52	10828.83	28905.43	23767.87
56. ANNUAL OWNERSHIP + OPRING COST	19981.86	25188.85	17465.73	37076.63	31501.56
VII. RELATIVE COSTS OF LIGHT					
59. RELATIVE COST EXCLUDING FIXED	1.35	1.86	1.78	2.19	2.07
60. RELATIVE TOTAL COST	1.34	1.69	1.17	2.49	2.12

FIGURE 27
SHEET 4 OF 6

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

SINGLE FENCE

	PERIMETER LIGHTING SCHEME 21 HPS + 50% Q	PERIMETER LIGHTING SCHEME 22 LPS W/O UPS	PERIMETER LIGHTING SCHEME 23 LPS + 100% Q	PERIMETER LIGHTING SCHEME 24 LPS + 75% Q	PERIMETER LIGHTING SCHEME 25 LPS + 50% Q
I. INITIAL EQUIPMENT INVESTMENT					
1. QUANTITY OF LUMINAIRES	335	160	320	320	400
3. LUMINAIRE COST TOTAL	40602.00	43680.00	54080.00	54080.00	53760.00
4. QUANTITY OF POLES	67	80	80	80	80
9. POLE + FOUNDATION COST TOTAL	4690.00	5600.00	5600.00	5600.00	5600.00
14. ELECTRICAL DISTRIBUTION	27872.00	4480.00	52480.00	36480.00	29490.00
14A. STANDBY GENERATOR COST	23691.20	3808.00	44608.00	31008.00	24209.00
14C. UPS COST	0.00	0.00	0.00	0.00	0.00
16. TOTAL INIT EQUIP INCL LAMPS	104560.20	60449.00	162048.00	132289.00	119048.00
17. RELATIVE INIT EQUIP INVESTMENT	1.86	1.07	2.88	2.35	2.10
II. INITIAL LABOR ESTIMATES					
20. NET LABOR, POLES + LUMINAIRES	30485.00	17200.00	29200.00	29200.00	31600.00
21. LABOR ELECTRICAL DISTRIBUTION	20904.00	3360.00	39360.00	27360.00	21350.00
22. TOTAL INITIAL LABOR	54176.20	21008.00	73808.00	60208.00	55808 [illegible]
23. TOTAL INITIAL INVESTMENT	158736.40	158841.00	235856.00	192496.00	17395[illegible]
24. RELATIVE INITIAL INVESTMENT	1.19	1.19	1.77	1.44	1
IV. ANNUAL COSTS					
31. TOTAL SYSTEM KW	139.	22.	262.	182.	142.
33. TOTAL ENERGY KWH/YEAR	157450.	89600.	94400.	92800.	92000.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00	0.00	0.00
37. ANNUAL KWH COST	3149.00				
370. DIESEL FUEL COST	222.98	35.84	419.84	291.84	227.84
40. REPLACEMENT LAMP COST	2612.00	921.60	957.60	955.20	968.40
V. ANNUAL MAINTENANCE, LABOR + MATERIALS					
44. RELAMPING COST - LABOR	235.73	170.67	178.67	178.67	182.67
47. CLEANING COST - LABOR	552.13	234.67	550.67	550.67	708.57
50. PAINTING COST - LABOR	0.00	0.00	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	968.55	575.68	1567.68	1271.68	1120.48
52. TOTAL ANNUAL MAINTENANCE COST	1756.42	981.01	2297.01	2001.01	2011.81
53. ANNUAL OPERATING COST	7740.39	3730.45	5562.45	5104.05	5048.05
VI. ANNUAL OWNERSHIP + OPERATING COST					
55. FIXED OWNERSHIP COST	21446.46	11157.79	32741.79	26607.39	23835.55
56. ANNUAL OWNERSHIP + OPRING COST	29186.85	14888.25	38304.25	31711.45	28883.61
VII. RELATIVE COSTS OF LIGHT					
59. RELATIVE COST EXCLUDING FIXED	2.07	1.00	1.49	1.37	1.35
60. RELATIVE TOTAL COST	1.96	1.00	2.57	2.13	1.94

FIGURE 27
Sheet 5 of 6

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

DOUBLE FENCE

	PERIMETER LIGHTING SCHEME 26	PERIMETER LIGHTING SCHEME 27	PERIMETER LIGHTING SCHEME 28
I. INITIAL EQUIPMENT INVESTMENT	100% QUARTZ	100% HPS	100% LPS
1. QUANTITY OF LUMINAIRES	160	100	134
3. LUMINAIRE COST TOTAL	10400.00	25000.00	48240.00
4. QUANTITY OF POLES	160	100	134
9. POLE + FOUNDATION COST TOTAL	11200.00	7000.00	9380.00
14. ELECTRICAL DISTRIBUTION	48000.00	11500.00	8040.00
14A. STANDBY GENERATOR COST	40800.00	9775.00	6834.00
14C. UPS COST	0.00	34500.00	24120.00
16. TOTAL INIT EQUIP INCL LAMPS	112800.00	91675.00	101036.00
17. RELATIVE INIT EQUIP INVESTMENT	1.23	1.00	1.10
II. INITIAL LABOR ESTIMATES			
20. NET LABOR, POLES + LUMINAIRES	36800.00	23000.00	30820.00
21. LABOR ELECTRICAL DISTRIBUTION	36000.00	8625.00	6030.00
22. TOTAL INITIAL LABOR	77600.00	37375.00	40870.00
23. TOTAL INITIAL INVESTMENT	190400.00	129050.00	141906.00
24. RELATIVE INITIAL INVESTMENT	1.48	1.00	1.10
IV. ANNUAL COSTS			
31. TOTAL SYSTEM KW	240.	58.	40.
33. TOTAL ENERGY KWH/YEAR	960000.	230000.	160800.
35. DEMAND CHARGE PER YEAR	0.00	0.00	0.00
37. ANNUAL KWH COST	19200.00		
37D. DIESEL FUEL COST	384.00	92.00	64.32
40. REPLACEMENT LAMP COST	7200.00	1440.00	1415.04
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
44. RELAMPING COST - LABOR	1600.00	123.08	142.93
47. CLEANING COST - LABOR	0.00	138.46	196.53
50. PAINTING COST - LABOR	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	1104.00	877.75	966.14
52. TOTAL ANNUAL MAINTENANCE COST	2704.00	1139.29	1305.61
53. ANNUAL OPERATING COST	29488.00	7271.29	6000.97
VI. ANNUAL OWNERSHIP + OPERATING COST			
55. FIXED OWNERSHIP COST	26696.00	17771.30	19522.73
56. ANNUAL OWNERSHIP + OP'ING COST	56184.00	25042.59	25523.69
VII. RELATIVE COSTS OF LIGHT			
59. RELATIVE COST EXCLUDING FIXED	4.91	1.21	1.00
60. RELATIVE TOTAL COST	2.24	1.00	1.02

FIGURE 27
Sheet 6 of 6

7-5 Miscellaneous Considerations. The vertical footcandle based criteria used for the perimeter lighting in 1975 favored a low mounting height of approximately 4 ft. The cost savings of a 5-foot mounting height over the 15-foot mounting then called for was approximately $1.00 per linear foot. The interference with operations in adjacent areas and to pilots from glare due to the corresponding high (almost 90°) vertical aiming angle would have been significant however. All photometric and economic analysis is contingent on the time period used for the operational life of the lamps. The maintenance factor is in turn determined based on that period. For the security lighting application of this study group relamping was assumed when 20% of the total lamps would have been spot replaced. (Refer to Table III and Figure 8).

1975 PERIMETER LIGHTING
KEY TO PROGRAM FORMAT

I. INITIAL EQUIPMENT INVESTMENT

1.	Quantity of luminaires	: Given
2.	Luminaire cost each	: Given
3.	Luminaire cost total	: 1 x 2 (Step 1 x Step 2)
4.	Quantity of poles	: Given
5.	Mounting Height	: Given
6.	Pole and bracket cost each	: Given
7.	Pole cost total	: 4 x 6
8.	Foundation cost each	: Given
9.	Pole and foundation cost total	: 4 x (6+8)
10.	Quantity of lamps per luminaire	: Given
11.	Quantity of lamps	: 1 x 10
12.	Lamp cost each	: Given
13.	Lamp cost total	: 11 x 12
14.	Electrical distribution	: ($200)*x 31
14A.	Cost of standby generator	: ($170)*x 31
14C.	Cost of UPS (Uninterruptable Power Supply)	: ($750)*x 1 x30
15.	Total Initial equipment less lamps	: 3+9+14+14A+14B+14C
16.	Total initial equipment including lamps	: 15 + 13
17.	Relative initial equipment investment	: 16/Lowest system value

II. INITIAL LABOR ESTIMATES

18.	Pole erection and painting	: Given
19.	Luminaire labor cost	: Given
20.	Net labor, poles plus luminaires	: (4x18) + (1x19)
21.	Electrical distribution, labor	: ($150)* x 31
21A.	Labor cost, standby generator	: ($20)* x 31
21B.	Labor cost, UPS	: ($100)* x 1 x 30
22.	Total initial labor	: 20+21+21A+21B
23.	Total initial investment equipment and labor	: 16 + 22
24.	Relative initial investment	: 23/Lowest system value

Figure 28
Sheet 1 of 4

III. ILLUMINATION CALCULATIONS

25.	Spacing or area	: Given
26.	Utilization factor	: Calculated
27.	Maintenance factor (Percent lumen depreciation at time of group relamping x dirt factor.)	: Given
28.	Average maintained foot-candles per design criteria (Vertical for area lighting measured 3'-0" above ground level and approximately 2.0 FC Vertical average 3'-0" above ground level for boundary lighting.)	: Give = .5 FC or 2.0 FC
29.	Initial investment cost per lineal foot or acre (Either Step 23 or Step 25 x Step 4 will be entered into program depending on whether perimeter lighting (linear feet) or area lighting (acres) is being examined.)	: 23 : 25 x 4

IV. ANNUAL COSTS

	KW per liminaire	: Given
30.	KW per luminaire	: Given
30A.	KW for UPS power loss (25% x Step 30)	: Given
31.	Total system KW	: 1 x 30 + 30A
32.	Annual operation (4000 hrs for boundary lighting and 200 hours for area lighting. 4000 hours selected for boundary lighting compares favorably with the Air Force computer analysis (See Attach No. 16) of lighting required at 28 separate bases. The Air Force analysis averaged 4089 hours with full 2 FC horizontal illumination maintained under cloudy sky conditions. The 200 hours for area lighting is based on 5 percent of the hours of darkness and is estimated to be a maximum average figure and includes a weekly 30 minute test load on standby generators,	: Given

Figure 28
Sheet 2 of 4

daily operation and inspection tests, time for alerts, construction operations and loading and unloading operations.)

33.	Total energy KWH per year	: 31 x 32
34.	Energy cost per KWH ($0.02/per KWH is used for energy cost in this study. Present (Aug 75) average Air Force costs are $0.014 /KWH and expected to increase.)	: Given
35.	Demand charge/KW/month	: Given
36.	Demand charge per year	: 31 x 35 x (12 months)*
37.	Annual KWH cost	: 33 x 34
37A.	Diesel fuel cost/gal	: $0.40
37B.	Fuel consumption rate Gal/KWH	: $0.08
37C.	Diesel operating hrs/year (Estimate of weekly tests and emergency operation)	: 50
37D.	Diesel fuel cost	: 31x37Ax37Bx37C
38.	Group relamping period (From lamp curves where spot replacement approaches 20% or lumen depreciation drops 20% or more	: Given
38A.	Rated lamp life, hours	: Given
38B.	Portion lamps spot-replaced	: Given
39.	Quantity replacement lamps	: 11 (1.0 + 38B) x 32/38
40.	Replacement lamp cost	: 39 x 12

V. ANNUAL MAINTENANCE, LABOR & MATERIALS

41.	Cost of labor $/manhour	: $10.00
42.	Group relamping time naire (including cleani	: .3 manhour
42A.	Spot relamping tim naire (including cleaning)	: .5 manhour
43.	Group relamping/year/luminaire	: 32/38
43A.	Spot relampings/year/luminaire	: 38B x 43
44.	Relamping cost - labor	: 1x41x(42x43+42Ax43A)
45.	Cleaning time/luminaire	: 0.2 manhour
46.	Cleanings/year/luminaire (If negative, Step 46 = 0) (Assumes one annual cleaning. Where annual operating hours exceeds group lamp repalcement fixtures will only be cleaned at a time of group replacement.)	: 1.0 - 32/38

Figure 28
Sheet 3 of 4

47. Cleaning cost - labor : 1x41x45x46
48. Painting time per pole : Given
49. Paintings/year/pole : 0.2
50. Painting cost - labor : 4x41x48x49
51. Replacement parts, paint, etc. : 1% x 15
52. Total annual maintenance : 44+47+50+51
53. Annual operating costs : 36+37+37D+40+52
54. Annual operating cost per Lineal Foot or acre : 53/(25x4)

VI. ANNUAL OWNERSHIP & OPERATING COST

55. Fixed ownership cost : 14.2% x (15+22)
(Cost % = $\frac{i\ (1+i)n}{(1+i)n-1}$
i = interest at 7%
n = functional life at 10 years
Note: It is assumed lighting system will be obsolete in 10 years due to technical advances and/or change in mission. It is further assumed cost of salvage will equal salvage value.)

56. Annual Ownership and Operating Cost : 53+55

57. Annual Ownership and Operating Cost per linear foot or acre : 57/(25x4)

*All figures in the parenthesis identified by asterisks represent items which were calculated internally (in the computer program) and which would not appear in the actual printout.

Figure 28
Sheet 4 of 4

TYPICAL ECONOMIC ANALYSIS PRINTOUT
(Single Fence - Perimeter Lighting)

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 1	TEST 50 2X500W QUARTZ H100 V93 60 DEGREE AIMING HORIZONTAL POSITION 60 _ 135 DEGREES		
		TOTAL FOR SYSTEM	2X500W QTZ Q500WMGE 60 FT SP 15 FT MTG
I.	INITIAL EQUIPMENT INVESTMENT		
1.	QUANTITY OF LUMINAIRES	268	268
2.	LUMINAIRE COST EACH		42.00
3.	LUMINAIRE COST TOTAL	11256.00	11256.00
4.	QUANTITY OF POLES	134	134
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		9380.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	9380.00	9360.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		268
12.	LAMP COST EACH		13.00
13.	LAMP COST TOTAL	3484.00	3484.00
14.	ELECTRICAL DISTRIBUTION	26800.00	26800.00
14A.	STANDBY GENERATOR COST	22780.00	22780.00
14C.	UPS COST	0.00	0.00
15.	TOTAL INIT EQUIP LESS LAMPS		70216.00
16.	TOTAL INIT EQUIP INCL LAMPS	73700.00	73700.00
II.	INITIAL LABOR ESTIMATES		
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		60.00
20.	NET LABOR, POLES + LUMINAIRES	36850.00	36850.00
21.	LABOR ELECTRICAL DISTRIBUTION	20100.00	20100.00
21A.	LABOR STANDBY GENERATOR	2680.00	2680.00
21B.	LABOR UPS	0.00	0.00
22.	TOTAL INITIAL LABOR	59630.00	59630.00
23.	TOTAL INITIAL INVESTMENT	133330.00	133330.00
III.	ILLUMINATION CALCULATIONS		
25.	SPACING OR AREA		60.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.81
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	16.58	16.58

FIGURE 29
Sheet 1 of 2

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

PERIMETER	TEST 50 2X500W QUARTZ H100 V93		
LIGHTING	60 DEGREE AIMING		
SCHEME 1	HORIZONTAL POSITION 60 135 DEGREES		
		TOTAL FOR SYSTEM	2X500W QTZ Q500WMGE 60 FT SP 15 FT MTG
IV. ANNUAL COSTS			
30.	KW PER LUMINAIRE		.50
30A.	KW UPS POWER LOSS		0.00
31.	TOTAL SYSTEM KW	134.	134.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	536000.	536000.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	10720.00	10720.00
37D.	DIESEL FUEL COST	214.40	214.40
38.	GROUP RELAMPING PERIOD (HOURS)		1600.
38A.	RATED LAMP LIFE (HOURS)		2000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		804.
40.	REPLACEMENT LAMP COST	10452.00	10452.00
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		2.50
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.5000
44.	RELAMPING COST - LABOR	2680.00	2680.00
46.	CLEANINGS/YEAR/LUMINAIRE		0.00
47.	CLEANING COST - LABOR	0.00	0.00
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	702.16	702.16
52.	TOTAL ANNUAL MAINTENANCE COST	3382.16	3382.16
53.	ANNUAL OPERATING COST	24768.56	24768.56
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	3.08	3.08
VI. ANNUAL OWNERSHIP + OPERATING COST			
55.	FIXED OWNERSHIP COST	18438.13	18438.13
56.	ANNUAL OWNERSHIP + OP"NG COST	43206.69	43206.69
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~ *	5.37	5.37

Non-applicable terminology has been crossed out in printout. The program was set up to print out either "per lineal foot" or "per acre" price depending on whether input data (Item III 25) is in feet (perimeter lighting) or square feet (area lighting)

FIGURE 29
Sheet 2 of 2

E - Variable quantities or descriptive material to be entered by user for each run.

F - Fixed costs or quantities applicable to a specific project - to be entered on the initial run only.

[hatched box] - ~~Items or material which will be~~ calculated or printed automatically ~~by the computer~~

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

		TOTAL FOR SYSTEM	E
I. INITIAL EQUIPMENT INVESTMENT			
1.	QUANTITY OF LUMINAIRES		E
2.	LUMINAIRE COST EACH		
3.	LUMINAIRE COST TOTAL		
4.	QUANTITY OF POLES		E
5.	MOUNTING HEIGHT		E
6.	POLE + BRACKET COST EACH		
7.	POLE COST TOTAL		
8.	FOUNDATION COST EACH		E
9.	POLE + FOUNDATION COST TOTAL		
10.	QTY LAMPS PER LUMINAIRE		E
11.	QUANTITY LAMPS		
12.	LAMP COST EACH		E
13.	LAMP COST TOTAL		
14.	ELECTRICAL DISTRIBUTION		F
14A.	STANDBY GENERATOR COST		F
14C.	UPS COST		F
15.	TOTAL INIT EQUIP LESS LAMPS		
16.	TOTAL INIT EQUIP INCL LAMPS		
II. INITIAL LABOR ESTIMATES			
18.	POLE ERECTION + PAINTING		E
19.	LUMINAIRE LABOR		E
20.	NET LABOR, POLES + LUMINAIRES		
21.	LABOR ELECTRICAL DISTRIBUTION		F
21A.	LABOR STANDBY GENERATOR		F
21B.	LABOR UPS		F
22.	TOTAL INITIAL LABOR		
23.	TOTAL INITIAL INVESTMENT		
III. ILLUMINATION CALCULATIONS			
25.	SPACING OR AREA		E
26.	UTILIZATION FACTOR		E
27.	MAINTENANCE FACTOR		E
28.	DESIGN FOOTCANDLES		E
29.	INIT COST PER LINEAL FT OR ACRE		

Cross out inapplicable term

COMPUTER PRINTOUT FORMAT

ECONOMIC ANALYSIS

FIGURE 30
Sheet 1 of -

ECONOMIC COMPARISION

TOTAL FOR SYSTEM

IV. ANNUAL COSTS

30. KW PER LUMINAIRE — E
30A. KW UPS POWER LOSS — E
31. TOTAL SYSTEM KW
32. ANNUAL OPERATION (HOURS) — E
33. TOTAL ENERGY KWH/YEAR
34. ENERGY COST PER KWH — E
35. DEMAND CHARGE/KW/MONTH — E
36. DEMAND CHARGE PER YEAR
37. ANNUAL KWH COST
37A. *DIESEL FUEL COST/GAL* — F
37B. *FUEL CONSUMPTION RATE (GAL/KWH)* — F
37C. *DIESEL OPERATING HOURS/YEAR* — F
37D. DIESEL FUEL COST
38. GROUP RELAMPING PERIOD (HOURS) — E
38A. RATED LAMP LIFE (HOURS) — E
38B. PORTION OF LAMPS SPOT REPLACED — E
39. QUANTITY OF REPLACEMENT LAMPS
40. REPLACEMENT LAMP COST

V. ANNUAL MAINTENANCE, LABOR + MATERIALS

41. *COST OF LABOR ($/MANHOUR)* — F
43. GROUP RELAMPINGS/YEAR/LUMINAIRE
43A. SPOT RELAMPINGS/YEAR/LUMINAIRE
44. RELAMPING COST - LABOR
46. CLEANINGS/YEAR/LUMINAIRE
47. CLEANING COST - LABOR
48. PAINTING TIME PER POLE — E
50. PAINTING COST - LABOR
51. REPLACEMENT PARTS, PAINT, ETC.
52. TOTAL ANNUAL MAINTENANCE COST
53. ANNUAL OPERATING COST
54. ANNUAL OP"NG COST PER FT OR ACRE

VI. ANNUAL OWNERSHIP + OPERATING COST

55. *INTEREST RATE* — F
56. *FUNCTIONAL LIFE* — F
57. FIXED OWNERSHIP COST
58. ANNUAL OWNERSHIP + OP"ING COST
59. TOTAL PER $\boxed{\text{LINEAL FOOT}}$ $\boxed{\text{OR ACRE}}$

Cross out inapplicable item

COMPUTER PRINTOUT FORMAT

ECONOMIC ANALYSIS

FIGURE 30
Sheet 2 of 2

ENPUT SHEET ECONOMIC ANALYSIS

00100 SYS
00110 SYS
00120 SYS
00130 SYS
00140 COMP
00150 COMP
00160 COMP
00170 COMP
00180 NUMG-NUMBER OF GROUPS OF COMPONENTS
00190 F1-QUANTITY OF LUMINAIRES
00200 F2-LUMINAIRE COST EACH
00210 F4-QUANTITY OF POLES
00220 F5-MOUNTING HEIGHT
00230 F6-POLE + BRACKET COST
00240 F8-FOUNDATION COST
00250 F10-QUANTITY OF LAMPS PER LUMINAIRE
00260 F12-LAMP COST EACH
00270 F30-KW PER LUMINAIRE
00280 F30A-UPS POWER LOSS (OF LOAD KW)
00290 F18-POLE ERECTION + PAINTING
00300 F19-LUMINAIRE LABOR COST
00310 F25-SPACING OR AREA
00320 F26-UTILIZATION FACTOR
00330 F27-MAINTENANCE FACTOR
00340 F28-AVERAGE MAINTAINED FC
00350 F32-ANNUAL OPERATION
00360 F34-ENERGY COST PER KWH
00370 F35-DEMAND CHARGE/KW/MONTH
00380 F38-GROUP RELAMPING PERIOD (HOURS)
00390 F38A-LAMP LIFE (HOURS)
00400 F38B-PORTION OF LAMPS SPOT REPLACED
00410 F40-PAINTING TIME PER POLE

FIGURE 31

8. RESULTS OF PERIMETER LIGHTING ANALYSIS. The perimeter lighting schemes outlined in Section 4-2.2 and 7-3 can be grouped in various ways and different aspects compared. Figure 32 represents a relative comparison of quartz, high pressure sodium and low pressure sodium systems on a per year basis. Figure 33 lists actual costs of each scheme on a 10 year basis. The figures it includes for the spill light configurations mentioned in paragraph 4-2.2 correspond to the HPS or LPS with UPS categories of Figure 32. Although this analysis was conducted using floodlights, the comparison would be valid, on a relative basis, to roadway configurations also.

8-1 Summary. The schemes analyzed can be grouped into four basic categories in summarizing results: quartz versus sodium vapor (high or low pressure) with UPS, with quartz backup, or without either UPS or quartz backup.

8-1.1. All Quartz System. This system has the largest annual ownership cost and consumes the most energy. Reliability of system is good. Outages would be limited to the time it takes for a standby generator to start up, approximately 25 seconds.

8-1.2. Sodium Vapor with UPS. This system has relatively low ownership and operating costs and power consumption. Reliability is good with no outages while the system is in operation. From a security standpoint this is the best system.

8-1.3. Sodium Vapor Without UPS or Quartz Backup. This system has the lowest annual operating and ownership costs and the lowest power consumption. Reliability is fair. With loss of commercial power, the H.P. sodium lamp will be out during standby generator start-up and will take up to 2 minutes for restrike. L.P. sodium will be back to full illumination in approximately 2 minutes. Area lighting could be turned on during restrike period to partially illuminate the boundary area by spill light. This system does not meet criteria time limit on outage. This arrangement is objectionable from a security standpoint since security personnel inside the secure area would not be in relative darkness compared to an intruder.

8-1.4. Sodium Vapor with Quartz Backup. This system has relatively high ownership and operating costs and low energy consumption. Reliability is good with outage only while standby power is starting, approximately 25 seconds.

8-2 Conclusions.

8-2.1. The 100% quartz system is the least desirable due to costs and energy use.

8-2.2. Sodium vapor with quartz backup costs more than the more reliable sodium with UPS system.

8-2.3. Sodium vapor without UPS, although the most attractive from a cost and energy use standpoint, does not however meet criteria relative to outage time. Temporary use of area lighting to furnish spill light would be objectionable from a security standpoint.

8-2.4. Sodium vapor with UPS meets the criteria without power outage, has relatively low cost and power consumption. This system has lowest cost if the system of paragraph 8-2.3. above can not be used.

8-2.5. The low pressure sodium light source for one fence and two fence configurations appears to be the best selection particularly in the light of rising energy costs. However a L.P. sodium system has the following disadvantages that are difficult to effectively evaluate:

a. A monochromatic light output that obliterates color rendition. The yellow light requires "some getting used to".

b. Although there are now a number of manufacturers of L.P. luminaires, (roadway, floodlights, etc.) in this country (see Attachment 7), major companies such as General Electric remain opposed to it.

c. The light source is large and precise beam control is more difficult to achieve compared to HPS and most other sources.

d. There is no known U.S. manufacturer of lamps. Lamps must be supplied from foreign sources. This has impact on "gold flow" and could affect availability under hot or cold war conditions.

e. Complete test data by independent testing laboratories was not available. The system is relatively new to the U.S. and sufficient field data is not available to substantiate all claims made by manufacturers' representatives.

8-3 Action Taken. The 1975 draft version of the lighting study recommended use of either high or low pressure sodium with UPS backup. The high pressure sodium version received subsequent Air Force approval. The low pressure sodium configuration, although somewhat lower in cost, was rejected because of possible lamp replacement problems due to the overseas source. The scheme consisting of high pressure sodium without UPS backup but using spill light from adjacent area lighting was determined to be unsatisfactory since there would be no light during generator start-up and then only partial illumination until the HPS source could build up to full lumen output. It was determined that the interior area should remain in darkness for security reasons.

COMPARISON OF PERIMETER LIGHTING-ONE YEAR BASIS

Scheme	Description	Relative Cost (order)	KW-HR Per Year	Energy Saving Per Year KW-HR	Annual Cost Ownership & Operating	Cost Savings Per Year One Site	Cost Savings Per Year 50 Sites
1	100% Quartz	2.90 (11)	536,000	0	43,207.00	00,000.00	000,000.00
8	HPS + UPS	1.61 (4)	194,000	342,000	24,021.00	19,186.00	959,300.00
10	LPS + UPS	1.25 (3)	112,000	424,000	18,667.00	24,540.00	1,227,000.00
18	HPS w/o UPS	1.17 (2)	155,000	381,000	17,466.00	25,741.00	1,287,050.00
22	LPS w/o UPS	1.00 (1)	90,000	476,000	14,888.00	28,319.00	1,415,950.00
19	HPS + 100% Q	2.49 (9)	159,000	377,000	37,077.00	6,130.00	306,500.00
20	HPS + 75% Q	2.12 (7)	158,000	378,000	31,502.00	11,705.00	585,250.00
21	HPS + 50% Q	1.96 (6)	157,000	379,000	29,187.00	14,020.00	701,000.00
23	LPS + 100% Q	2.57 (10)	64,000	412,000	38,304.00	4,903.00	245,150.00
24	LPS + 75% Q	2.13 (8)	93,000	443,000	31,711.00	11,496.00	574,800.00
25	LPS + 50% Q	1.94 (5)	92,000	444,000	28,884.00	14,323.00	716,150.00

FIGURE 32

COMPARISON OF PERIMETER LIGHTING - 10 YEAR BASIS

	A	B	C	D	E	F
CONFIGURATION	100% Q	HPS+UPS	HPS + 100% Q	HPS + 75% Q	HPS + 50% Q	HPS + AREA SPILL
OWNERSHIP COST PER SITE (AVE. 8,000 LF)	184,400	162,600	289,000	237,700	214,500	108,300
ELECTRICAL ENERGY COST - 10 YRS	107,200	38,900	31,900	31,600	31,500	31,100
RELAMPING COST - 10 YRS	131,300	28,000	28,400	28,300	28,500	28,000
MAINTENANCE COST - 10 YRS	9,200	10,700	21,500	17,400	17,400	7,300
TOTAL LIFE COST PER SITE	432,100	240,200	370,800	315,000	291,900	174,700
TOTAL 50 SITES FOR SAC ALERT AREAS & WEAPONS STORAGE AREAS - 10 YRS (400,000LF)	21.6 MIL	12.0 MIL	18.5 MIL	15.8 MIL	14.6 MIL	8.7 MIL
TOTAL SAVINGS - 10 YRS		9.6 MIL	3.1 MIL	5.8 MIL	7.0 MIL	12.9 MIL
(Relative Standing)	(11)	(4)	(9)	(7)	(6)	(2)

FIGURE 33
SHEET 1 of 2

COMPARISON OF PERIMETER LIGHTING - 10 YEAR BASIS

	G	H	I	J	K
CONFIGURATION	LFS+UPS	LPS + 100% Q	LPS + 75% Q	LPS + 50% Q	LPS + AREA SPILL
OWNERSHIP CCST PER SITE (AVE. 8,000 LF)	142,900	324,400	266,100	238,400	111,600
ELECTRICAL ENERGY COST - 10 YRS	22,400	18,900	18,600	18,400	17,900
RELAMPING COST - 10 YRS	10,900	11,400	11,300	11,500	10,900
MAINTENANCE COST - 10 YRS	10,400	25,400	21,[illegible]	20,600	8,500
TOTAL LIFE COST PER SITE	186,600	383,100	317,100	288,900	148,900
TOTAL 50 SITES FOR SAC ALERT AREAS & WEAPONS					
STORAGE AREAS - 10 YRS (400,000 LF)	9.3 MIL	19.1 MIL	15.8 MIL	14.4 MIL	7.4 MIL
TOTAL SAVINGS - 10 YRS	12.3 MIL	2.5 MIL	5.8 MIL	7.2 MIL	14.2 MIL
(RELATIVE STANDING)	(3)	(10)	(7)	(5)	(1)

FIGURE 33
SHEET 2 of 2

9. DESIGN CONSIDERATIONS - FORMAT/OPTIMIZATION.

9-1 Area Lighting - Optimization.

9-1.1. Mounting Height. When illumination criteria is based on vertical footcandle (FC) measurement, and there are no constraints relative to vertical aiming of the luminaire or uniformity of illumination, the most efficient arrangement is to place the luminaire at the same height as the object, line, plane, etc that is to be illuminated per criteria. If there are constraints on vertical aiming (see below), raising the mounting height will increase the light projection in front of the pole line (i.e. a greater span can be illuminated to criteria levels). For most situations, 40 foot is a practical limit to luminaire placement. Above this height there is a pronounced escalation in cost of poles and maintenance ("cherry pickers" can't be used). Mounting heights over 40 feet are justified for applications such as center sector lighting where poles must be located outside the area that is to be lighted. The greater the distance that poles must be set back, the higher the mounting height should be. The alternative is increased energy cost due to a greater number of luminaires or higher installation cost for more poles. Ten year costs favor higher poles. The lighting uniformity ratio will also be improved by raising the mounting height (or by increasing the pole setback in the case of center sector lighting).

9-1.2. Vertical Aiming. As the discussion above indicates, the most efficient configuration for a vertical FC format is to mount floodlights at the same level as the object(s) to be illuminated while aiming the beam of the floodlight directly at the object. This is equivalent to aiming at the horizon and corresponds to 90° vertical in the aiming format (see Figure 23) used in the computer analysis. This aiming angle however will also project the maximum amount of glare and may interfere with the performance of pilots and Security Police personnel. The IES Lighting Handbook recommends a maximum vertical aiming angle of 60°. This will eliminate most of the glare objectionable to the observer while still allowing a reasonable extent of area to be illuminated.

9-1.3. Beam Pattern. Wide beam patterns, in both horizontal and vertical orientations, are most suitable for area lighting. Most commercially available wide beam 1500 W floodlights have NEMA 6x5 (see Figure 16) beams.

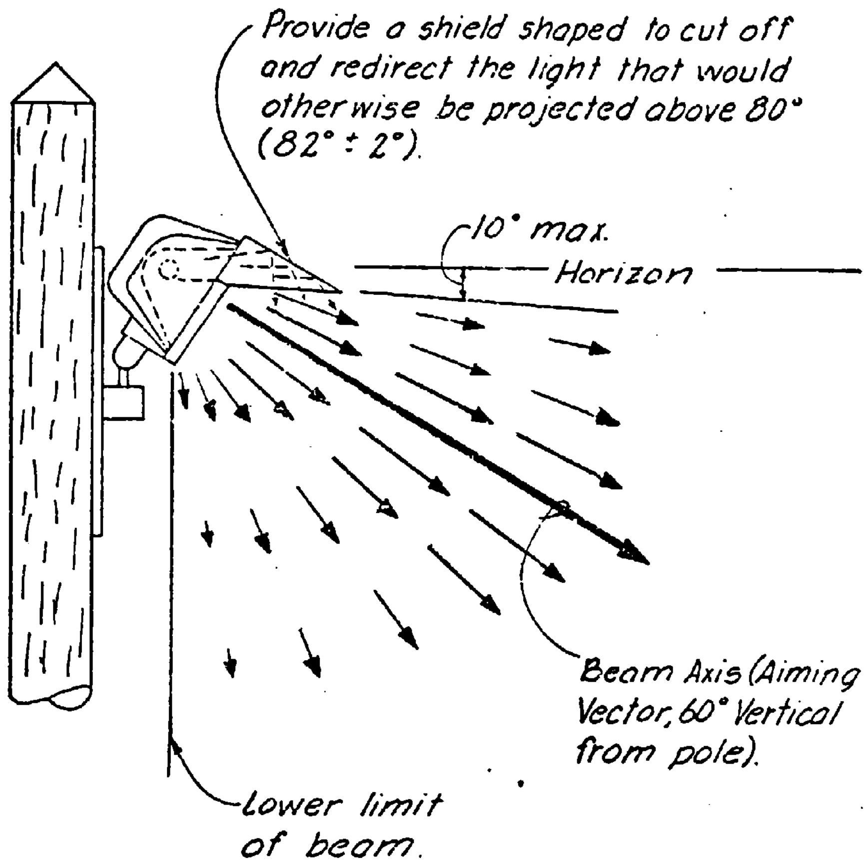
9-1.3.1. The vertical beam spread could range from 70° to 99° in width, although most 1500 W units available tend toward the higher figure (500 W units have narrower beams in most cases). Complete coverage is provided essentially from the pole to the horizon. Since a large portion of the light energy is above the beam axis, relatively wide pole spacing is possible

(see Fig. 34). A narrow vertical beam unit would concentrate the light, creating an intense "hot spot" at the 60° zone. Beam control on narrow beam units is achieved by means of highly polished (specular) reflectors which appear more intense to the observer and will thus generate more glare complaints. The wide beam reflector, however, has a diffuse surface making this floodlight inherently a lower glare unit (Note illustrations in Figure 16). Narrow vertical beam units, since they concentrate their light energy around the beam axis, are most suitable where narrow areas have to be lighted and vertical aiming can be over 75°. Taxiway gap lighting is an example of such an application. See Par. 9-6.

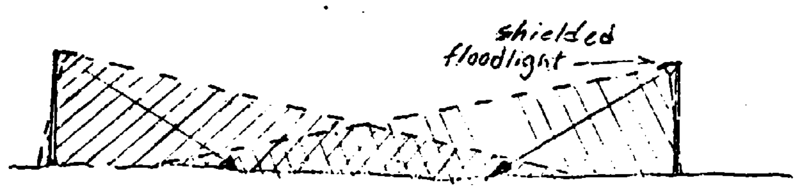
9-1.3.2. The horizontal beam spreads on most commercial units exceeds 120°. This rather wide spread permits 4 evenly spaced units to provide complete illumination around a pole with a relatively high degree of uniformity. If a spread of 90° or less is used there will be dark bands between adjacent luminaires. For this application, a minimum beam spread of 115° has been stipulated on definitive drawings. There are floodlights available in high pressure sodium versions with beam spans exceeding 140°. When used in high mast applications such as for interstate interchanges, the result has been an exceptionally uniform illumination without discernible weak spots.

9-1.4. Horizontal Aiming. A series of computerized tests were performed to determine which of various aiming formats provided the optimum results. When using wide beam units, it is most efficient to orientate 8, or 4, floodlights at 0°, 90°, 180°, and 270° around a pole (0° is referenced from the "X" axis which is aligned with the pole line). An arrangement using 8 evenly spaced (45° apart) is less efficient. A configuration having a pair of luminaires aimed 45°, 135°, 225° and 315°, horizontally will be the least efficient. To achieve optimum performance in area lighting an attempt should be made to create an essentially square light pattern around each pole. The corners of the "square" lie the greatest distance from the pole and will thus be the most difficult to illuminate. Selection of the "X" and "Y" axis for horizontal orientations of the floodlights enables contributions to be made from at least 2 units (4 & 8 luminaires per pole). It turns out that the candlepower intensity directed at the corner is stronger than that which could be obtained from a single floodlight aimed directly at the corner. Another factor which also tends to work against the second approach somewhat is that due to floodlight geometry the -7.8° plane intersects the corner vs the prime (or 0°) plane in the first approach. (See Figure 35). As indicated in par. 1-3.2. above, these advantages could not be obtained with narrow horizontal beam units. Six or eight aiming directions (and additional luminaires) would have to be employed vs the four directions used here. The above rules are applicable when light is to be projected in all directions from a pole. When light is to be projected in one direction away from a pole line, as in the case for center sector lighting, different formats must be used. (See Discussion below in par. 9-2.3. and single row application curves, Figure 40).

VERTICAL BEAM SPREAD CHARACTERISTICS



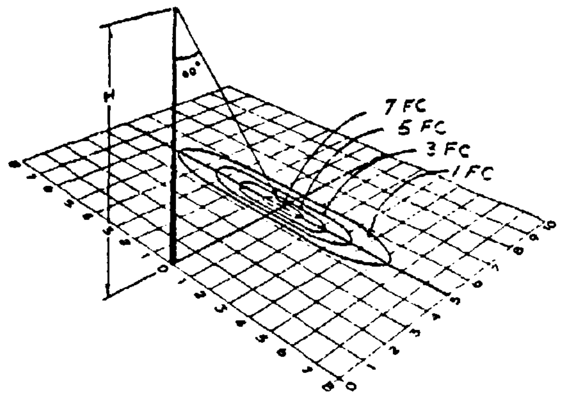
SHIELDING DETAIL



TYPICAL AREA LIGHTING CROSS SECTION

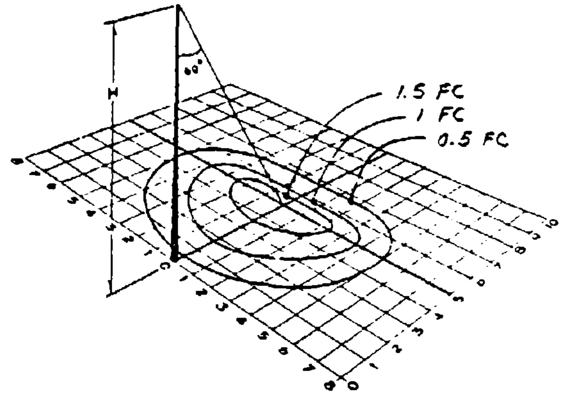
FIGURE 34
Sheet 1 of 2

1. NARROW
(20° H x 11°V)



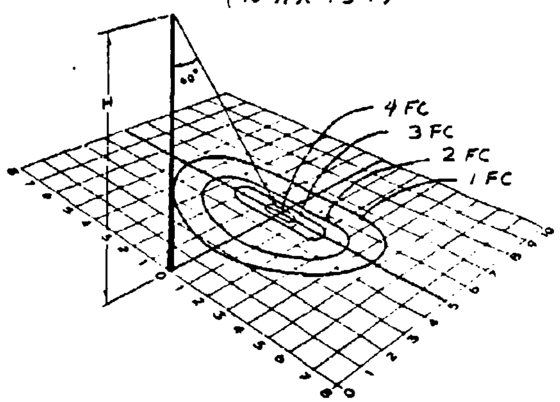
Max. illumination: 7 footcandles
Min. illumination: 1 footcandle
Ratio: 7:1

4. EXTRA-WIDE
(99°H x 53°V)

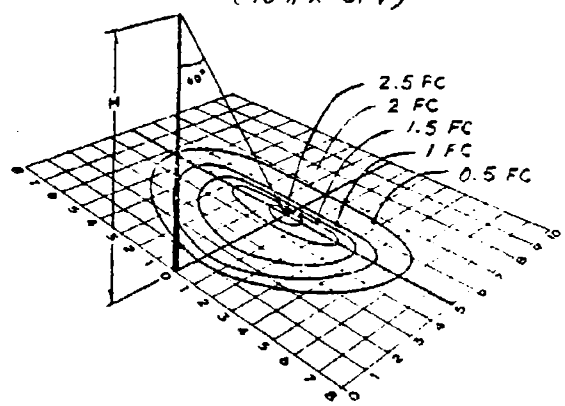


Max. illumination: 1.5 footcandles
Min. illumination: 0.5 footcandle
Ratio: 3:1

2. MEDIUM
(90°H x 45°V)



3. WIDE
(96°H x 51°V)

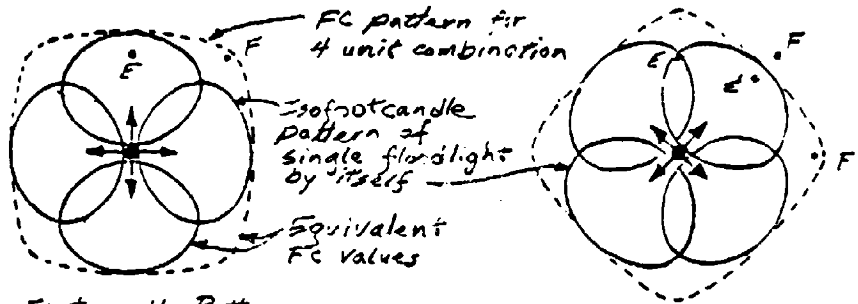


NOTE: The above isofootcandle curves are applicable to 500 W quartz floodlights mfr'd by Stonco Electric Products Co. (2500 series, catalog literature dated July 15, 1963). Mounting height is 30 ft.

Isofootcandle Curves - Wide vs. Narrow Beam Spread

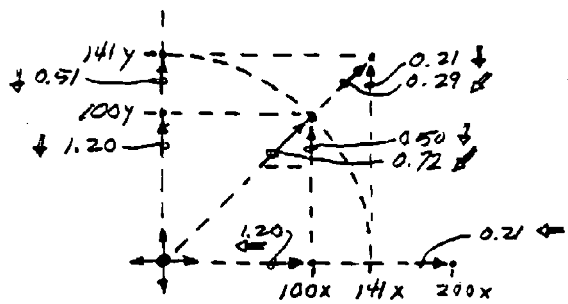
VERTICAL BEAM SPREAD CHARACTERISTICS

FIGURE 34
Sheet 2 of 2



Footcandle Patterns

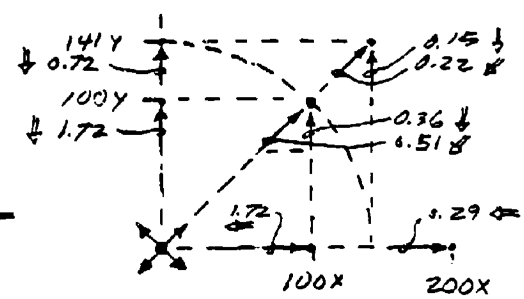
Footcandle Patterns



FC's at Specific Points

HORIZ. AIMING ALIGNED ON "X" and "Y" AXES

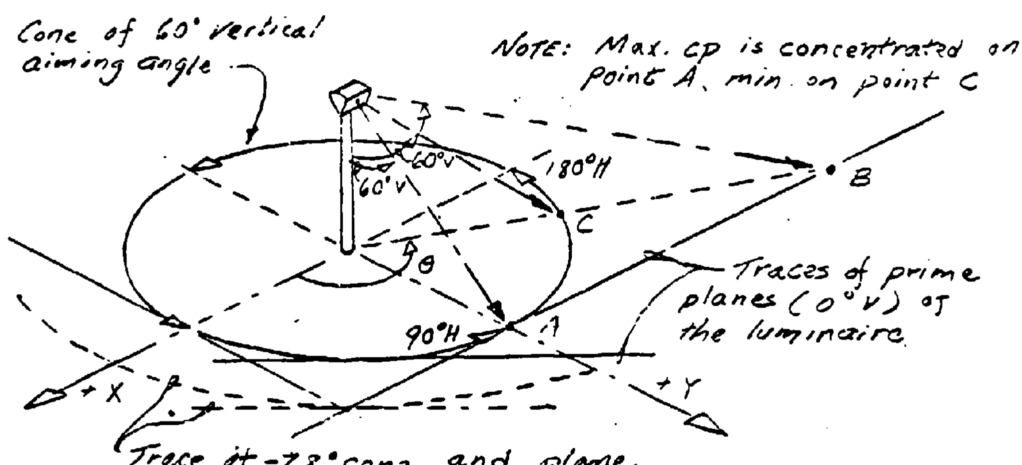
Computer Run: TE06



FC's at Specific Points

HORIZ. AIMING ALIGNED 45° from "X" – "Y" AXES

Computer Run: TE07



PHOTOMETRIC GEOMETRY OF FLOODLIGHT

FIGURE 35

9-1.5. Quantity of Luminaires Per Pole. From a purely photometric standpoint, increasing the number of poles (decreasing spacing between poles) will decrease the number of luminaires required for a given application. There would be savings in total wattage and thus energy costs. However those savings would be offset by higher installation costs besides the objectionable features of a "forest of poles". For this series of projects, the 8 luminaire per pole format was found to be most suitable for large square areas and most rectangular areas (i.e. multirow format). For long, somewhat narrow areas, the most efficient format, 4, 6, or 8 luminaires per pole, would depend on the dimensions of the particular area. Floodlights, for the purposes of this project, are availabe in one size commercially, 1500W. It is not feasible to adjust individual lamp wattages proportional to the dimensions of areas to be lighted. The 4 and 6 luminaire configurations, in some cases, may therefore be more efficient than 8 luminaires per pole. Where illumination is to be projected in one direction only and the pole must be set back from the area such as for center sector lighting, more than 8 luminaires may be required per pole. (See par 9-2.3.).

9-1.6. Shielding. Use of floodlights with wide vertical beam spreads will mean that in most cases there will be a small amount of spill light above the horizon. This stray light could interfere with pilots vision or could be a nuisance factor if residential areas are immediately adjacent. Glare shields such as detailed in Figure 34 will cut off light above 80° and redirect it downward.

9-1.7. Spacing vs Mounting Height. When designing area lighting around criteria given in terms of horizontal footcandles pole spacing should not, as a rule, be more than 4 times the luminaire mounting height. As this ratio is exceeded the number of luminaires required to maintain mimimum illumination will increase rapidly and uniformity of illumination (on horizontal FC basis) will become proportionately worse. When considered from a vertical FC basis, it is desirable to keep mounting height low relative to spacing. Uniformity, on a vertical FC basis, will be relatively good if the area immediately under the pole is discounted. Since the eye sees a combination of vertical and horizontal FC's, it is desirable to avoid extreme ratios with vertical FC formats also. A 10:1 ratio was the maximum obtained with the area lighting configuration used in this series of projects; 6:1 or 7:1 the more typical value.

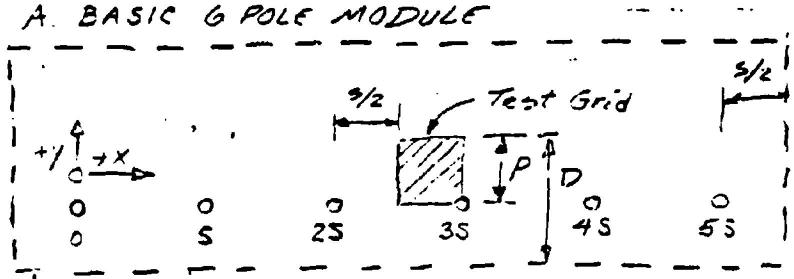
9-2 Area Lighting - Site Format.

9-2.1. General. All area lighting formats were developed using a 1500W quartz iodine floodlight with a NEMA 6x5 beam spread. If other beam spreads were substituted the formats described in this section would not, in most cases, remain valid without some modifications. The performance of the quartz lamp is extremely sensitive to fluctuations in line voltage. A lamp operating 5% below its design voltage will deliver only 85% of its rated lumen output. A configuration that would

yield 0.47 footcandles minimum under rated conditions would deliver 0.4 FC if there were 5% voltage drop in the supply line. The formats shown on the definitive drawings will provide the minimum illumination required by criteria while allowing a 5% maximum voltage drop in the circuits supplying the luminaires. Vertical aiming is 60° for all formats. The definitive site layouts and application curves assume use of a lamp having a 34400 lumen rating. Use of a lamp having a different rating would require that the curves be adjusted (per inverse square law of distance).

9-2.2. Single Row Configurations. Three distinct single row configurations have been detailed on sheets C8-C10A of the definitives for the convenience of the designer. See Figure 36 for a description of each type. The relatively wide spacing of the eight luminaire per pole configuration will illuminate a span 450 ft wide. The median 250 ft spacing of the six luminaire configuration will lighten a 420 ft. span, the narrow 200 ft. spacing of the four floodlight configuration will cover a 350 ft span. Mounting height is 40 ft in each case. A 6-pole module served as the basic format for computer analysis. It can be employed, in building block style, to form a row of any specific length necessary. The 50% spacing shown at each end of the module applies only if there will be another pole opposite to contribute half of the total illumination on the midpoint (S/2 from pole). At the ends of rows (or sectors if there is not another sector adjacent), therefore, supplemental luminaires must be installed to maintain the light level at criteria values. Figure 36 delineates the compensation required for sectors having 2,4, or 6 poles. If an adjacent sector could supply an "end" pole at the same spacing increment, the supplemental units could be omitted. Application curves (see Figures 39 and 40) have been prepared to assist in the selection of a lighting scheme for areas in which the above approaches might not be most efficient. Curves "B1, D1, B2," and D2" would be particularly well suited for applications where perimeter lighting and area lighting share common poles. Since illumination would be in one direction only, the lower set (180°-360°) of luminaires could be omitted - i.e. for Curve D1, delete units at 225° and 315°, retain those at 45° and 135°. All curves include an allowance for voltage drop not to exceed 5%.

A. BASIC 6 POLE MODULE



This basic module can be used to build up a row of any length desired. Supplemental floodlights must be installed on the end pole such as the compensated formats shown below for individual sectors.

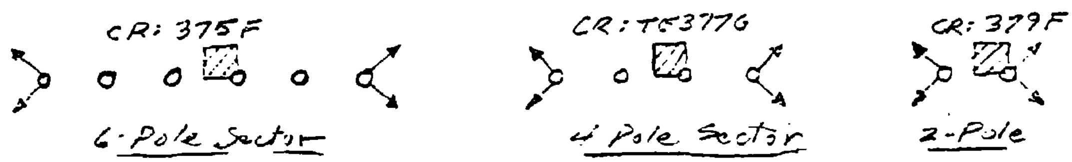
LEGEND

S = pole spacing (x direction)
S/2 = end zone dist. width of FC test grid
P = Projection (in "y" direction) of criteria illumination
D = 2P
MH = mounting ht = 40ft
HA = Horiz. Aiming
O = Pole w/ normal floodlight pattern
O = Pole with supplemental floodlight

B NARROW SPACING

4 x 1500 W quartz
MH 41, S200, P175, D350
HA = 0, 90, 180, 270°

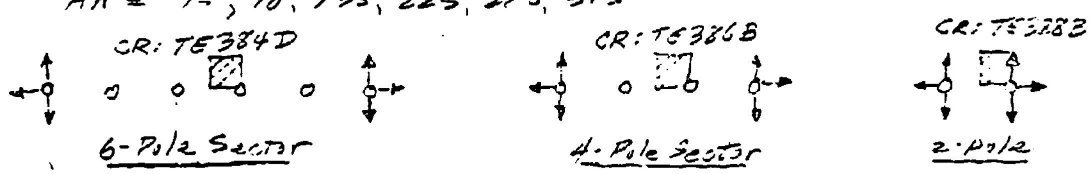
Basic CR: TE374C



C. MEDIUM SPACING

6 x 1500 W quartz
MH 40, S250, P210, D420
HA = 45, 90, 135, 225, 270, 315°

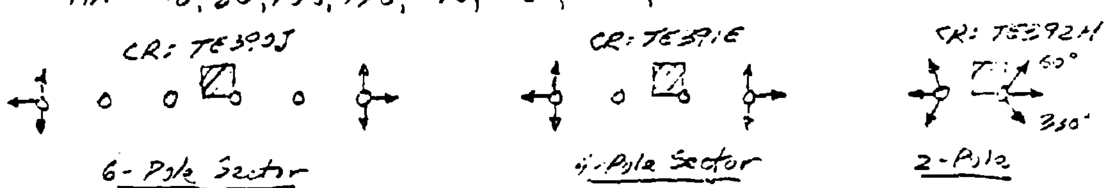
Basic Computer Run: TE383



D. WIDE SPACING

8 x 1500 W quartz
MH 40, S300, P225, D450
HA = 10, 80, 100, 170, 190, 260, 280, 350°

Basic Computer Run: TE390D

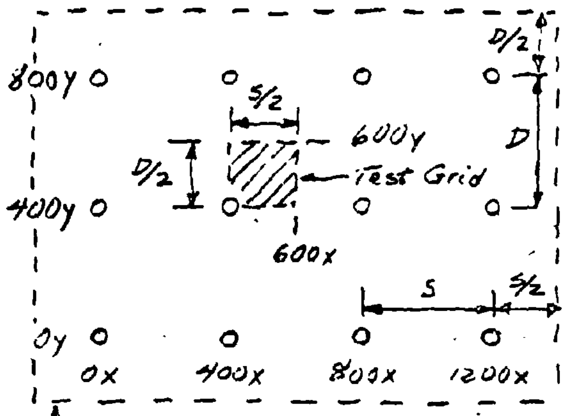


AREA LIGHTING - SINGLE ROW CONFIGURATIONS

Applic. Definitives: AD71-03-02, sh CI-00A FIGURE 36

9-2.3. Multirow Configurations. The eight luminaire format is the most suitable horizontal aiming arrangement for larger areas and was therefore used almost exclusively in computer analysis. A square spacing format (S=D) is most efficient economically for the wide beam, large area application. A 12 pole module was used in analysis of lighting configurations. Figure 37 contains the specifics of the various schemes used on Definitive Series AD 71-03-02, sheets C1-C3A. The maximum allowable pole spacing ranges from 340 ft for a 4 pole sector to 400 ft. for a 12-pole sector. Illumination at the corners of any sector standing alone will drop below criteria minimums and will require the addition of supplemental luminaires as indicated. This will not be necessary if there is an adjacent sector with a pole, positioned at the same spacing increment, that could contribute the required illumination. A standard spacing of 400 ft for sectors of 4-pole through 9-pole size can be maintained if a greater quantity of luminaires are installed per section "C" of Figure 37 to augment weak areas in the interior of the sectors. Mounting height is 40 ft in all cases. The application curves of Figure 41 can be used, at the designer's option, to select alternate spacing schemes than those depicted on the definitive drawings. These curves will maintain criteria illumination when the lamp is operated at 95% of rated voltage.

A. BASIC 12 POLE MODULE

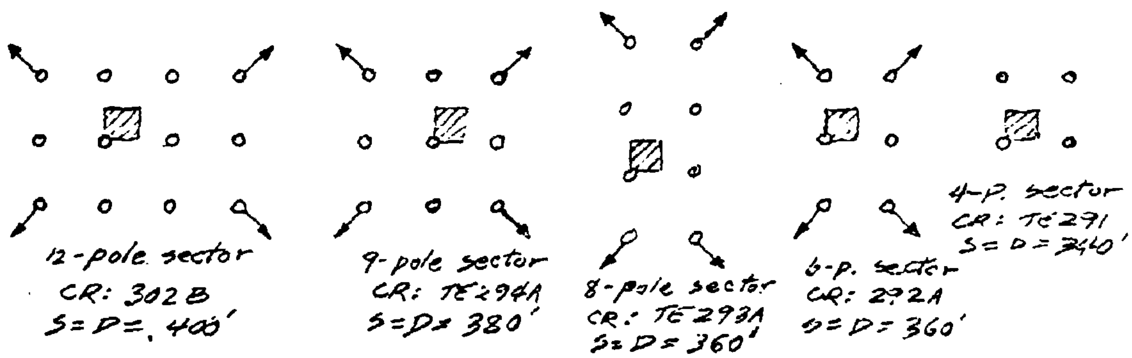


8 x 1500w quartz iodine
MH 40, VA 60
HA = 15, 75, 105, 165°
195, 255, 285, 345°

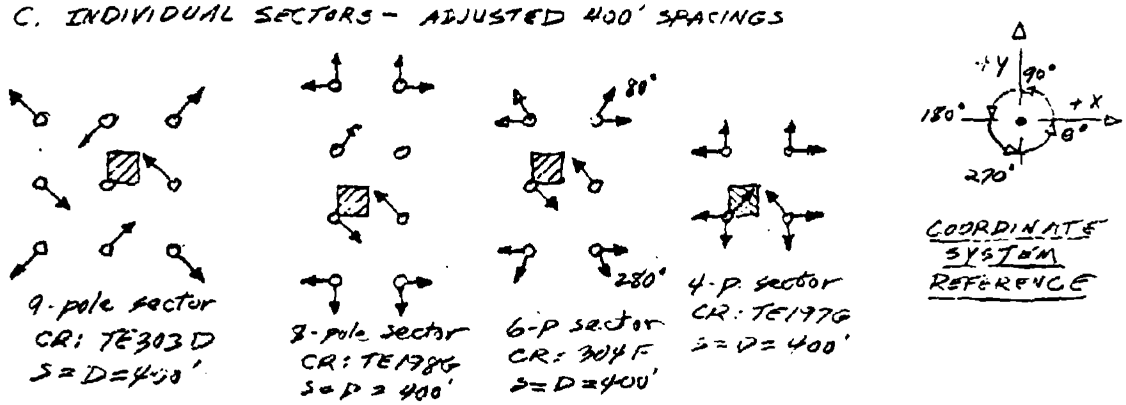
MH = mounting height = 40ft
S = pole spacing
D = distance between rows
HA = horizontal aiming
O = pole with standard number of floodlights
O = pole with additional supplemental floodlight.
CR = computer run

Modular area used in computer analysis. Compensated formats must be used for individual sectors. See below. Supplemental units may be omitted at any corners where there is an equivalent sector adjacent (See par. 9-2.3).

B INDIVIDUAL SECTORS - VARIABLE SPACINGS



C. INDIVIDUAL SECTORS - ADJUSTED 400' SPACINGS



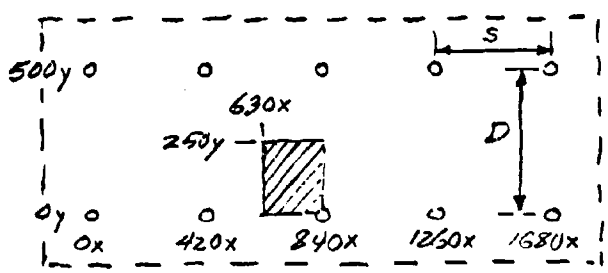
AREA LIGHTING - MULTIROW CONFIGURATIONS

Applicable Definitive: Series AD 71-43-02
Sheets C1-C3A

FIGURE 37

A. DOUBLE ROW – MEDIUM SPAN

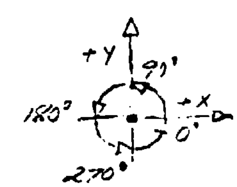
6 x 1500W quartz iodine
MH60, S420, VA60
D500, PS0, D'500
HA = 45 x 2, 80, 100, 135° x 2.
225 x 2, 260, 280, 315° x 2



Computer Run: TE355
No supplementation req'd at ends

LEGEND

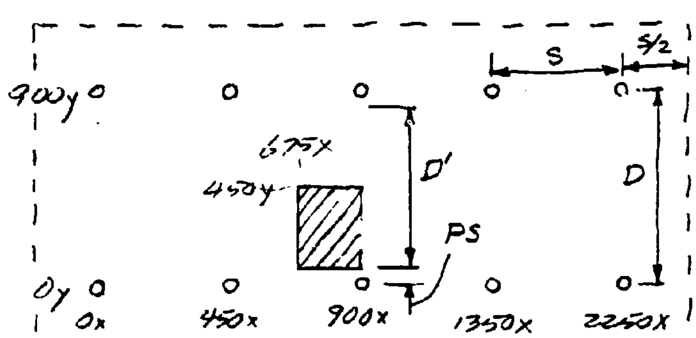
VA = vertical aiming
HA = horizontal aiming
MH = mounting height
P = pole spacing
D = distance between rows
PS = distance pole line must be set back from edge of sector
D' = maximum allowable sector width
o = pole with standard floodlight format
= pole with additional supplemental floodlights
CR = computer run



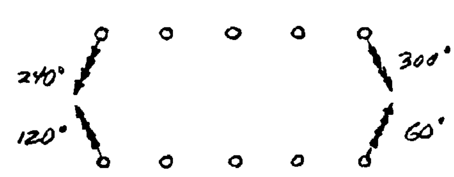
COORDINATE SYSTEM REFERENCE

B. DOUBLE ROW – WIDE SPAN

9 x 1500W quartz iodine
MH100, S450, VA60
D900, PS65, D'770
HA = 45, 90, (80, 100) x 3, 135°
225, 270, (260, 280) x 3, 315°



Computer Run: TE258



10 Pole Sector

CR: TE266

AREA LIGHTING - DOUBLE ROW CONFIGURATIONS
(CENTER SECTOR)

Applicable Definitives: AD 71-03-02, sh. C4-C7 100 FIGURE 58

9-2.4. Double Row Configurations. The double row area lighting configurations delineated on sheets C4-C7 of Definitive Series AD71-03-02 are intended to be applied to the center sector lighting of SAC "Christmas Tree" alert areas and to mass ramp alert areas. The medium span version (see Figure 38) is applicable to Christmas Tree ramps. Due to the ramp configuration poles have to spaced 420 ft apart laterally. When 6 luminaires are mounted at 60 ft. up, a 500 ft. wide span can be illuminated. No pole setback is necessary; the sector limit can be extended to the pole line. The wide span format applicable to the mass ramp has 9 floodlights mounted 100 ft up on structures spaced 450 ft apart laterally. The two rows are placed 900 ft. apart and require a 65 ft. pole setback (or 770 ft. maximum sector width) Supplemental units are required on the end poles of sectors having a large D:S ratio. Where this ratio is less than 1.2 to 1, as the Christmas tree application, supplemental floodlights can be omitted. The application curves of Figure 42 should provide a sufficient range of formats such that any alert configuration likely to be encountered should be covered. Eight horizontal aiming formats are available. The most efficient aiming angles in terms of the projection that can be achieved is 80° and 100° (260 and 280° for opposite row). If all units are grouped at these two angles however, there will be extensive criteria violations ("dark spots") near the pole lines, at the midpoint between poles. To keep these within acceptable limits at least one set of floodlights must be aimed at 45° and 135°. The number of pairs at these angles determines the extent to which the sector edges must be placed in front of the pole lines (pole setback). A family of curves has been prepared for 40,60, 80 and 100 ft. mounting heights. For a given spacing, the upper portion of a curve identifies corresponding maximum projection that the particular format will allow. The distance between the two rows can not exceed 2 x projection "P". The lower portion of the curve (A', B1', C1', etc) determines the pole setback required. The area enclosed by a set of curves exceeds criteria; a point lying outside fails to meet criteria, the extent of the violation being proportional to the distance from the curve(s). The above schemes all utilize the 1500 W quartz iodine lamp and permit 5% voltage drop to the lamp. A brief examination was made using a 20,000 watt long arc xenon source. It had equal or superior characteristics from a photometric basis, particularly color. Its high initial and replacement lamp cost however negated its photometric advantages to the extent that there was no real economic gain from its use. Applicable computer runs were "TEST335" and "TEST336."

9-2.5. Supplementation - Individual Luminaire. In designing area lighting there will be many instances requiring supplemental floodlights to adjust weak spots at ends or corners of sectors or around buildings or other obstructions. Sheet C13 of Definitive Series AD 71-03-02 contains isofootcandle curves of a single 1500W floodlight at 90° and 45° orientation for 180°, 225°, and 270° footcandle readings. These curves should be of assistance in determining location, number and orientation of supplemental units. The conversion graphs of Figures 43 and 44 can be utilized to adapt the isofootcandle curves to other mounting heights. The multiplier from Figure 43 should be applied to the footcandle values, the multiplier from Figure 44 to the longitudinal and transverse distance coordinates.

Eight Luminaires Per Pole

HA = 15, 75, 105, 165°
195, 255, 285, 345°

HA = (0, 90, 180, 270°) x 2

HA = (45, 135, 225, 315°) x 2

HA = (30, 150, 210, 330°) x 2

HA = (60, 120, 240, 300°) x 2

Four Luminaires Per Pole

HA = 0, 90, 180, 270°

HA = 45, 135, 225, 315°

HA - 30, 150, 210, 330°

HA = 60, 120, 240, 300°

Six Floodlights Per Pole

HA = 45, 90, 135, 225, 270, 315°

HA = 0, 45, 135, 180, 225, 315°

HA = 15, 90, 165, 195, 270, 345°

HA = 0, 75, 105, 180, 255, 285°

NOTE: Horiz. aiming format for double row configurations will be found on sheet 1 of FIGURE 42

HA: Horizontal aiming angle of individual luminaire. Reference (0°) line is the "x" axis. Angles are measured counterclockwise.

P = Projection - the max. distance from the pole line (in "y" direction) that the specified FC levels will be met.

S = Spacing (in "x" direction) between poles

D = Distance (in "y" direction) between rows of poles. "D" can't exceed "2P" without violating criteria.

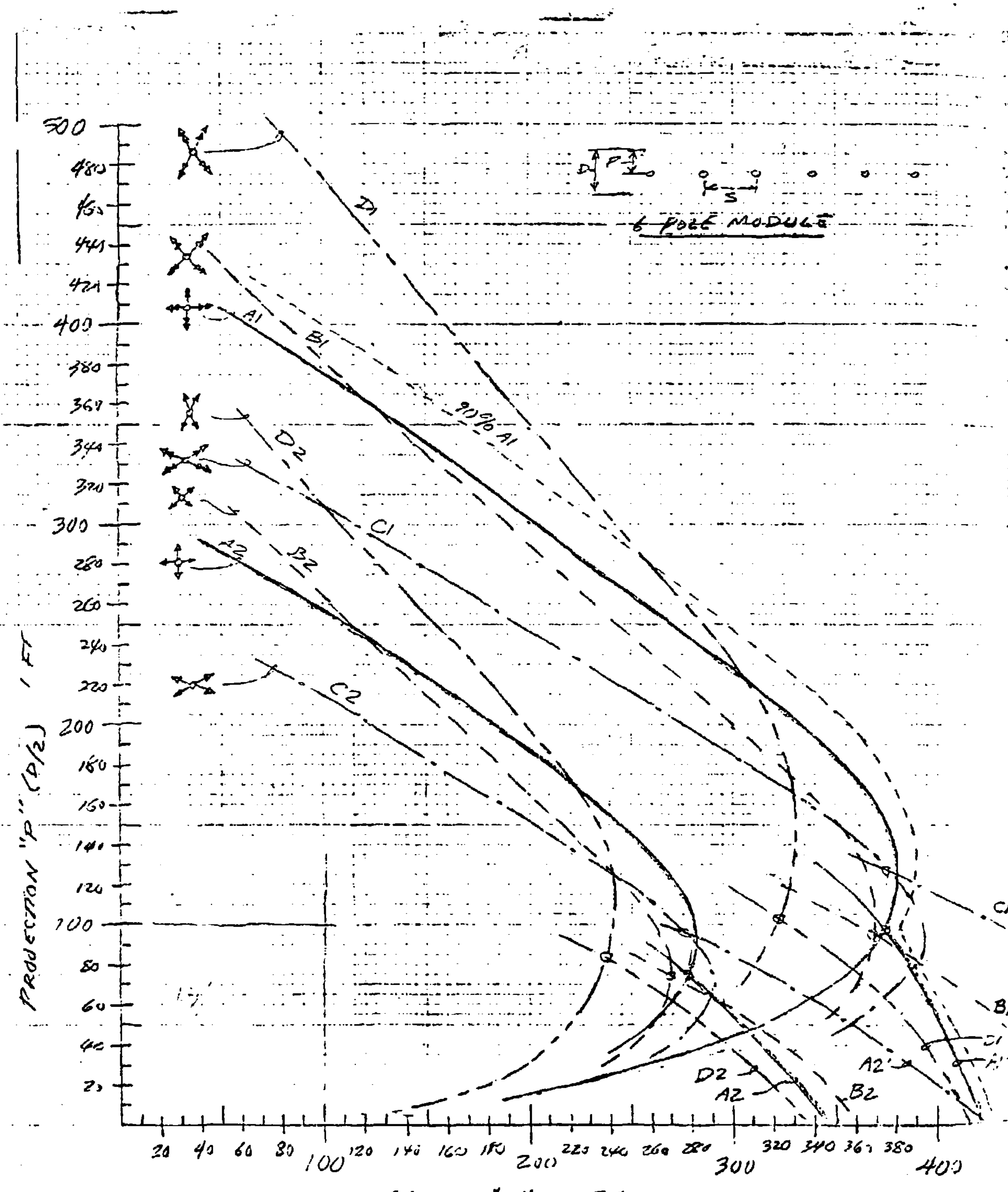
PS = Pole setback - the distance that the pole line must be set back from the area to be illuminated to insure that criteria illumination levels are met or, conversely, the min. distance that the border (of the area or sector) can be placed in front of the pole line without falling below criteria.

A / A' — Curve of projection vs. spacing for a specific FC. The plain letter(s) identify the relationship(s) that would apply when values measured at a 270° orientation are considered. The primed letter(s) correspond to the relationships obtained on a 180° (or 0°) basis. The curves will yield the criteria minimum of 0.4 vertical FC if total voltage drop from a rated voltage source does not exceed 5%.

90% C — Same as above except that deviations up to 10% below criteria for up to 5% of total no. of grid points are permitted.

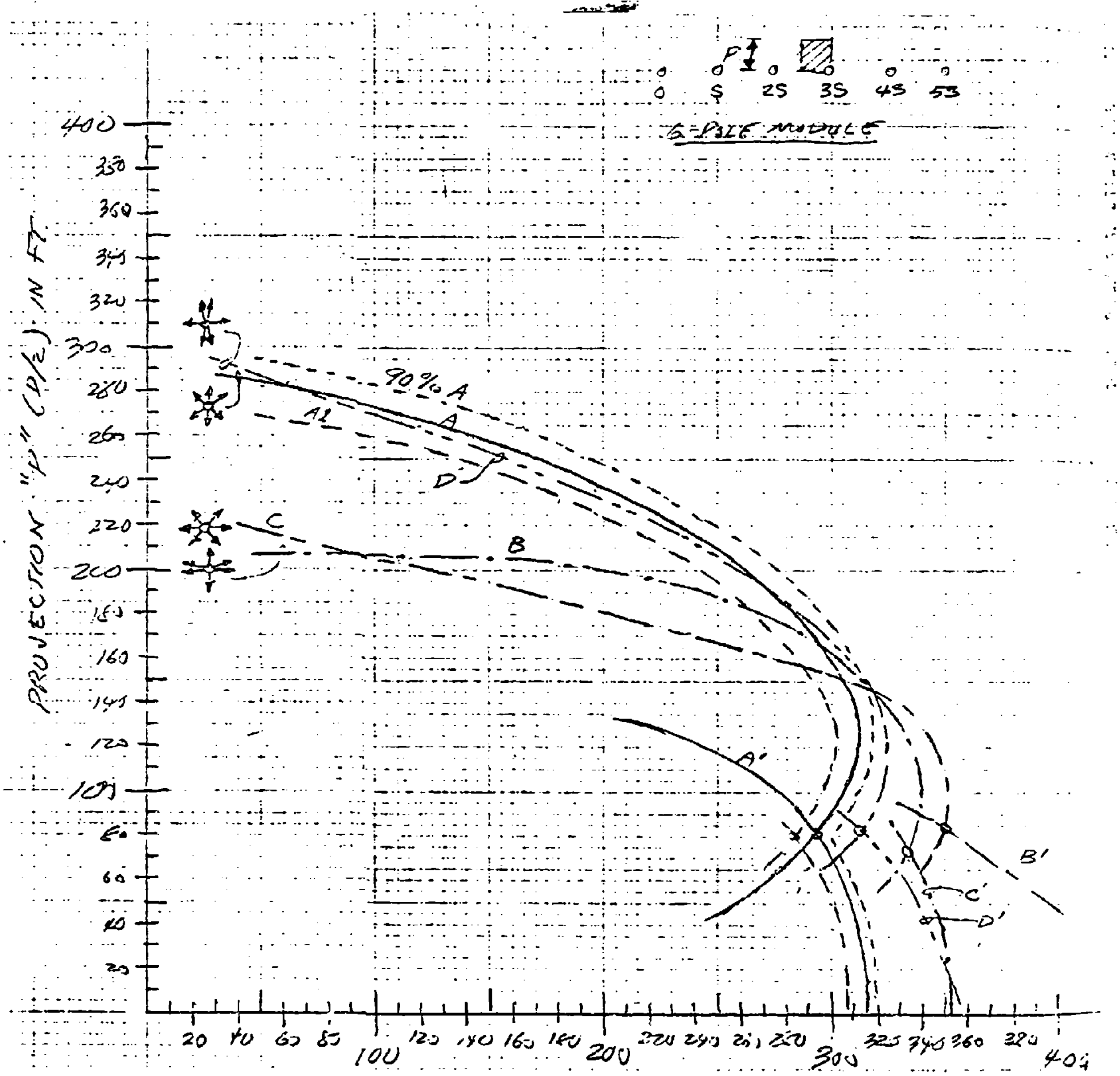
KEY TO FORMAT - AREA LIGHTING APPLICATION CURVES

Applicable Definitives: AD 71-03-02, Sh C11-C13



SINGLE ROW CURVES - 4 & 8 LUMINAIRE FORMATS
40 FT MOUNTING HEIGHT

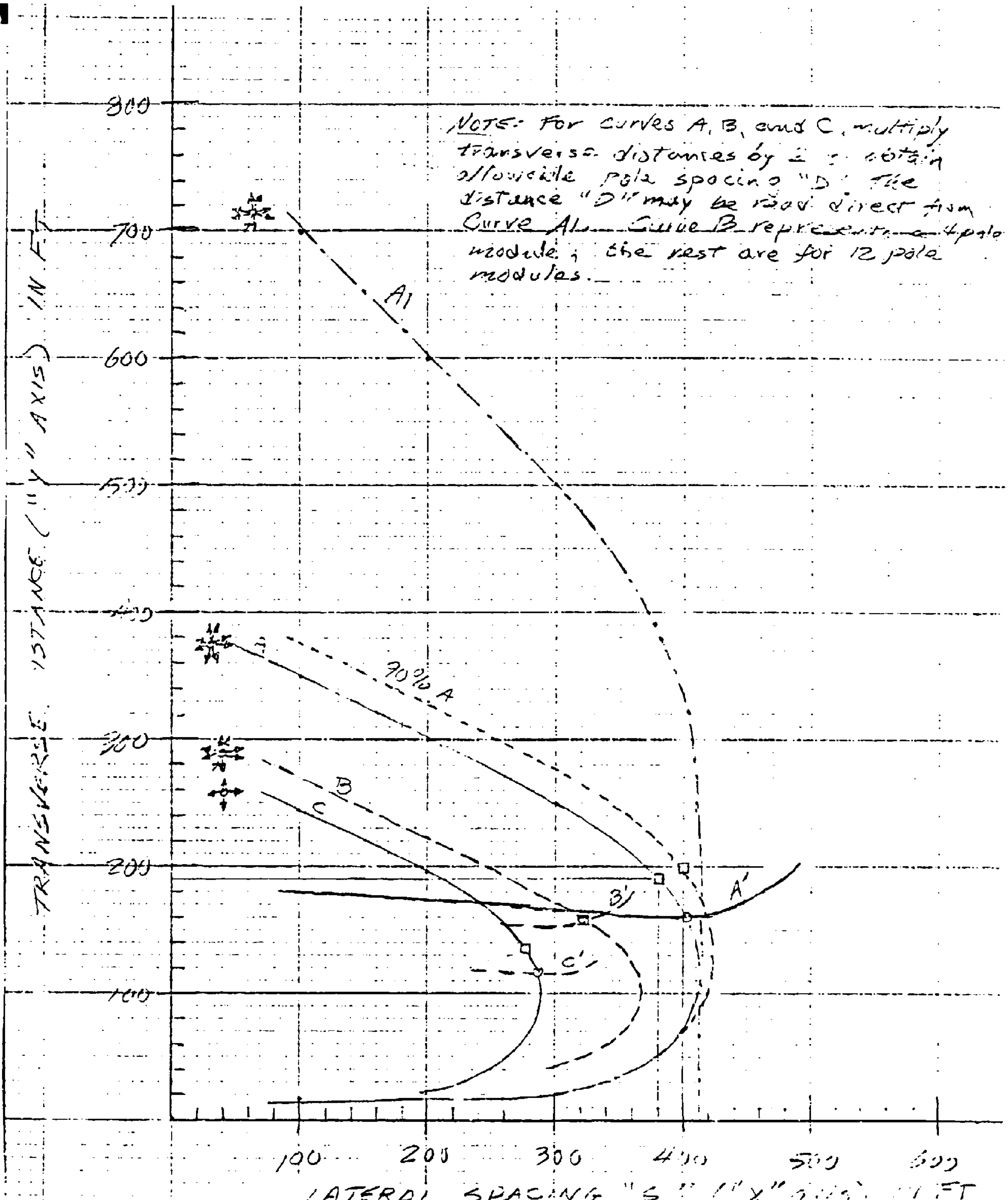
FIGURE 40
SA 1 of 2



SINGLE ROW CURVES - 6 LUMINAIRE FORMAT

40FT MOUNTING HEIGHT

FIGURE 40
Sh 2 of 2



AREA LIGHTING - MULTIROW

FIGURE 41

AREA LTG - DOUBLE ROW (CENTER SECTOR)

KEY TO CURVES

D PI S (UR) (LR)

A 6 6 15 floodlights
HA = 45°, (80,100)×5, 90, 135
225, (260,280)×5, 270, 315

B1 5 5 12 floodlights
HA = 45, (80,100)×5, 135 ← Lower Row (LR) of poles
225, (260, 280)×5, 315 ← Upper Row (UR)

C1 9 floodlights
HA = 45, (80,100)×3, 90, 135
225, (260,280)×3, 270, 315

D1 6 floodlights
HA = 45, (80, 100)×2, 135
225, (260, 280)×2, 315

B2 12 floodlights
HA = 45°×2, (80°, 100°)×4, 135°×2
225°×2, (260, 280)×4, 315×2

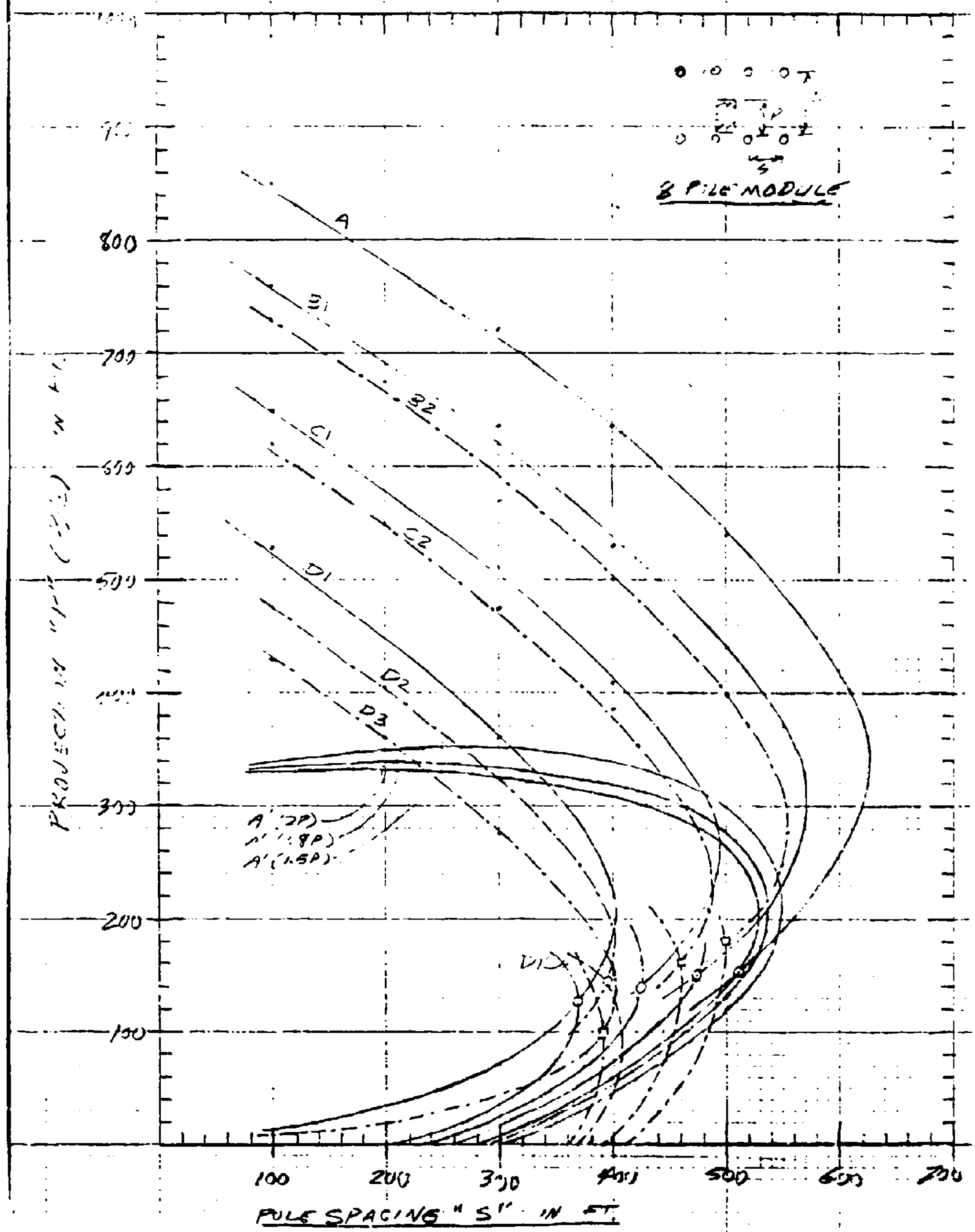
C2 9 floodlights
HA = (45, 80)×2, 90, (100, 135)×2
(225, 260)×2, 270, (280 315)×2

D2 6 floodlights
HA = 45×2, 80, 100, 135×2
225×2, 260, 280, 315×2

D3 6 floodlights
HA = (45, 135)×3
(225, 315)×3

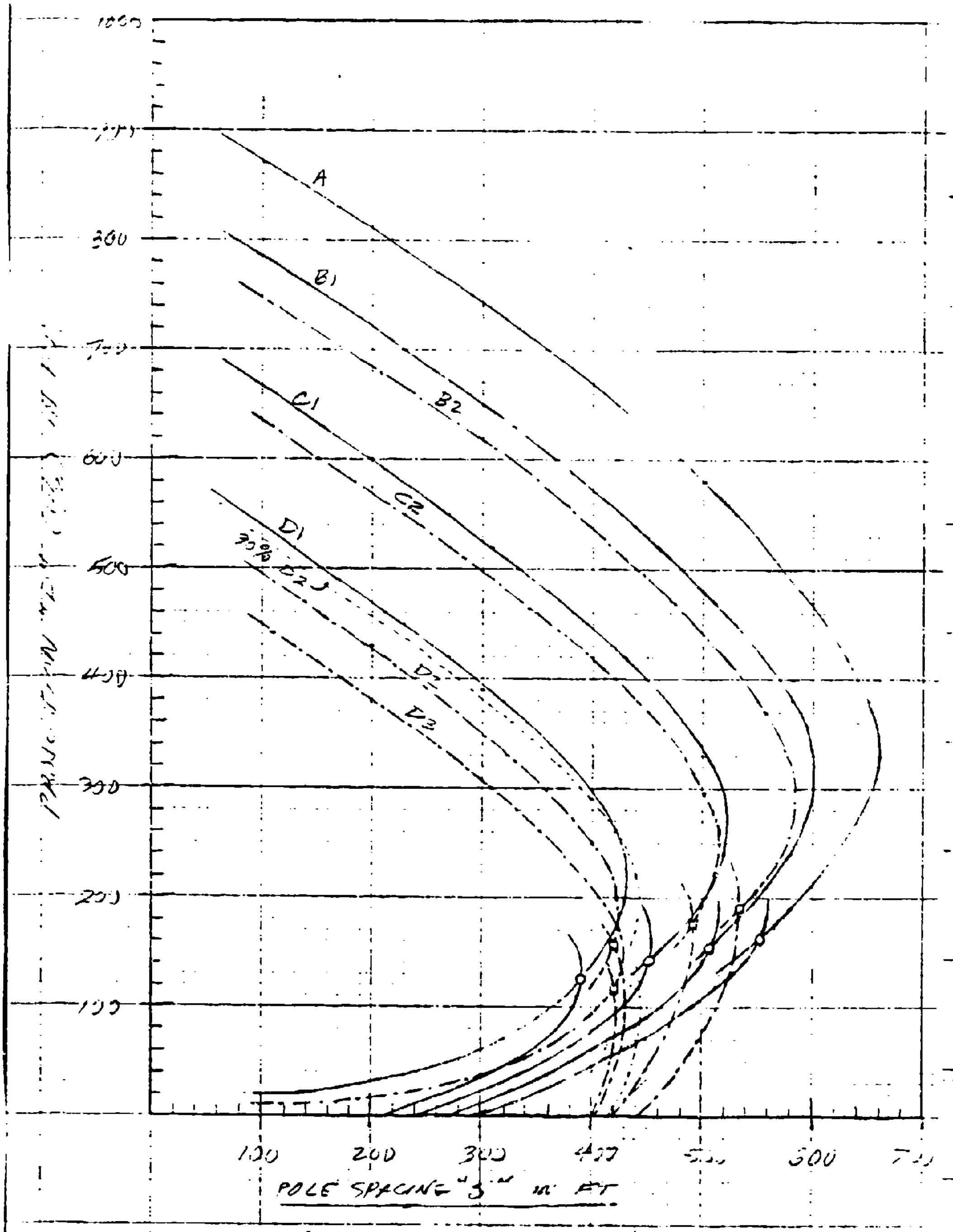
} 270° ⇓ FC measurement

} 0° ⇒ FC measurement



40 FT. MOUNTING HEIGHT

FIGURE 42
Sh 2 of 5



60 FT MOUNTING HEIGHT

FIGURE 42
Sh. 3 of 5

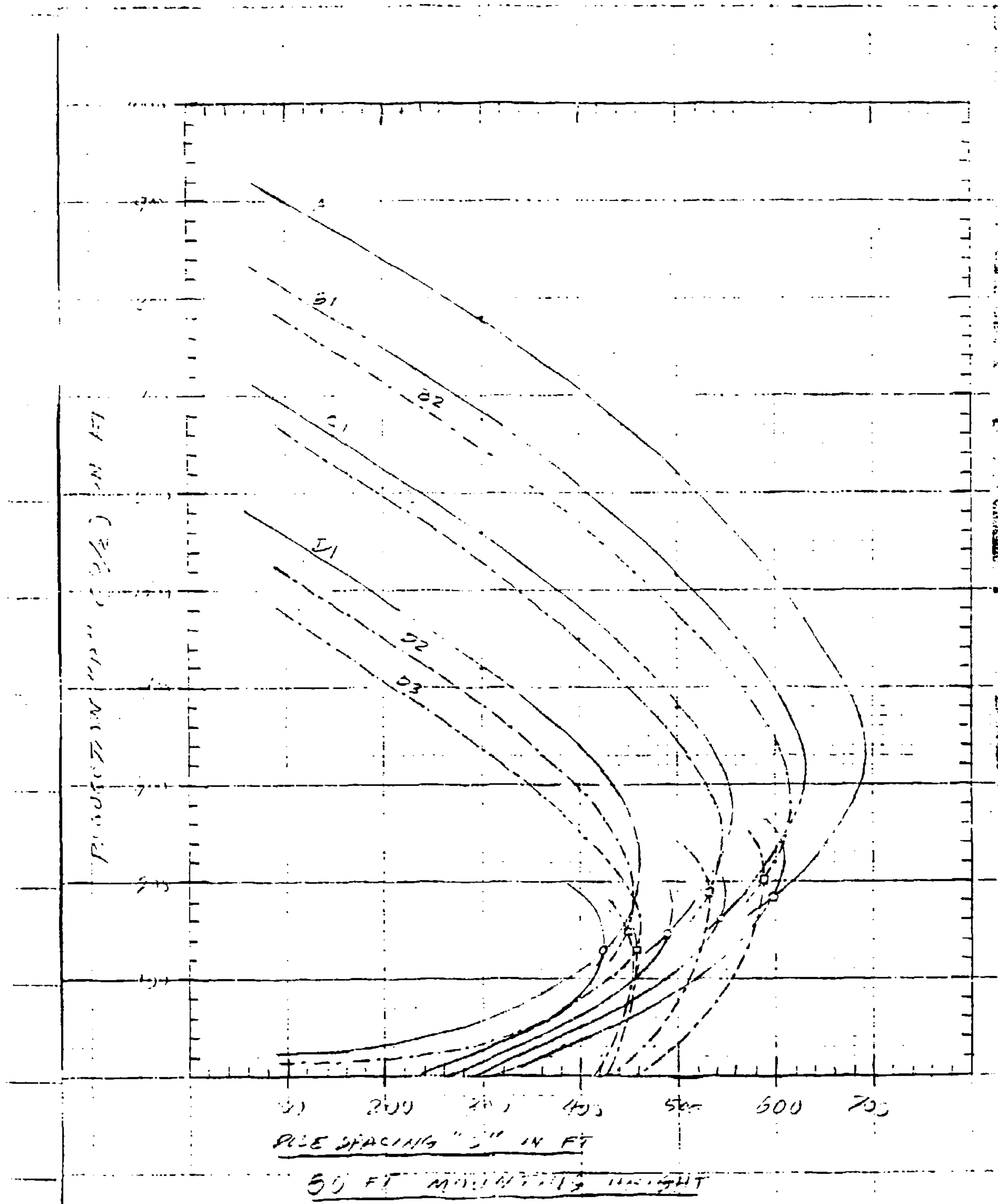
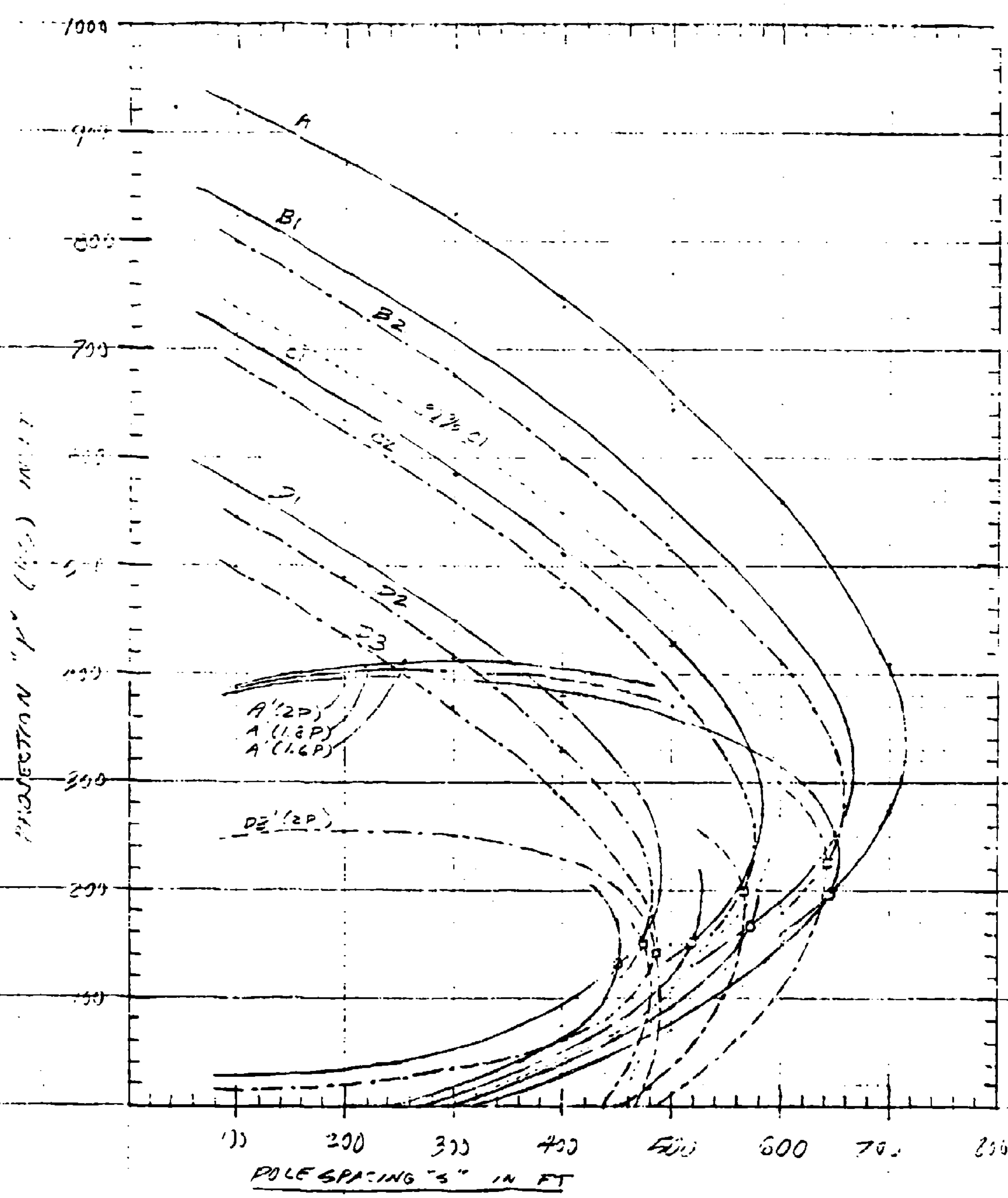
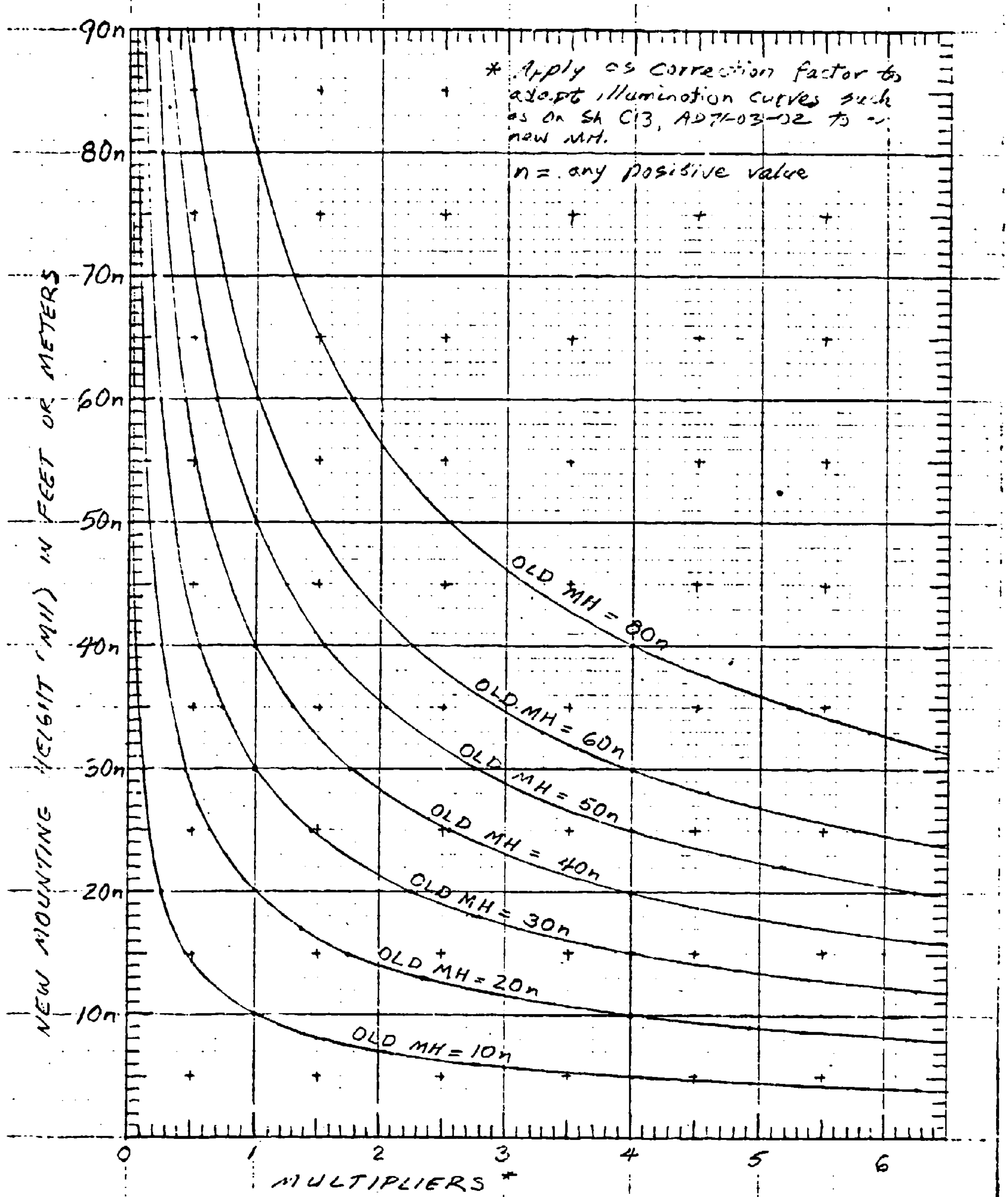

A
B1
B2
C1
D1
D2
D3
200
600
PLE SPACING "S" IN FT
50 FT MOUNTING HEIGHT

FIGURE 42



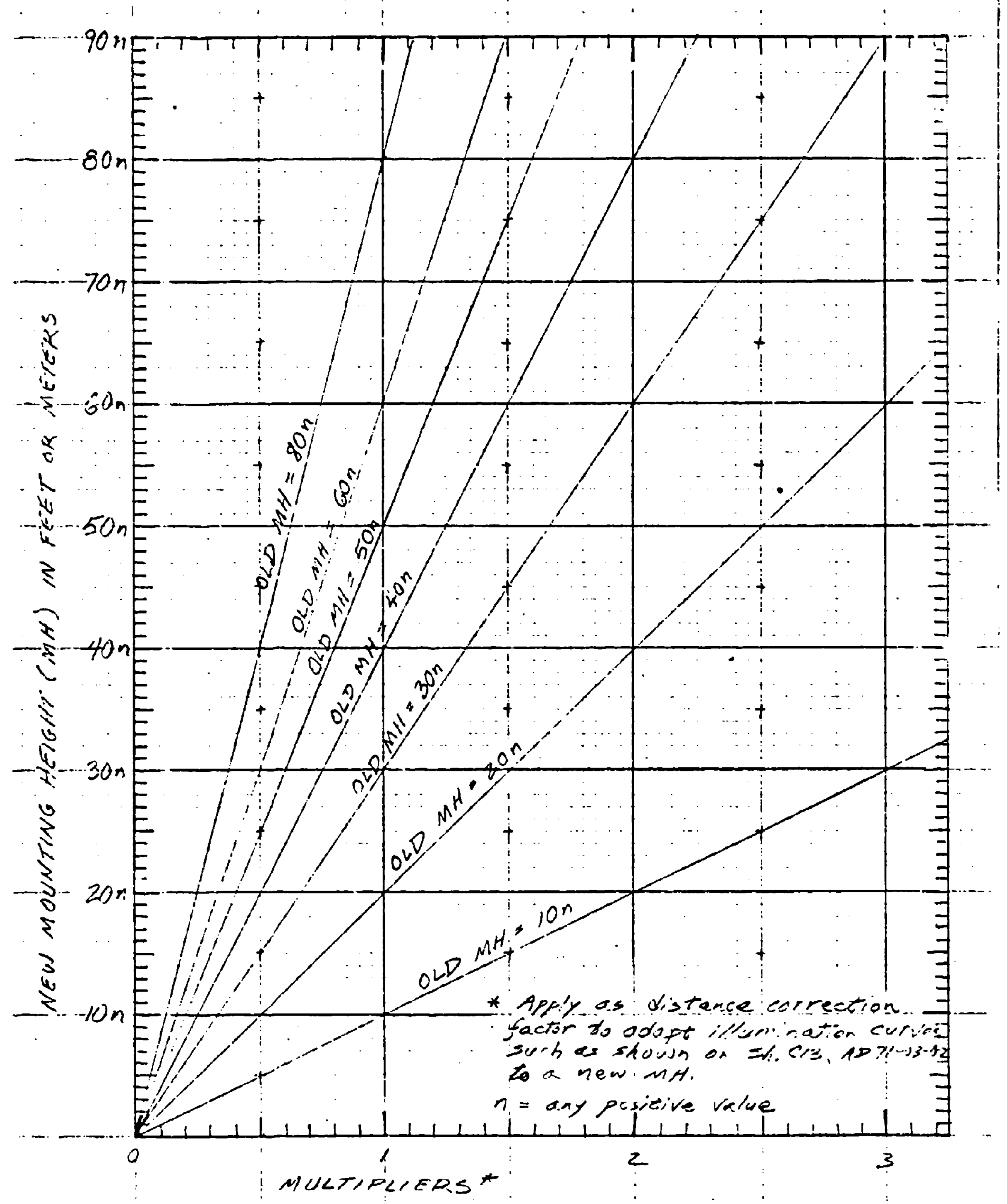
100 FT. MOUNTING HEIGHT

FIGURE 42
Sh 5 of 5



ILLUMINATION CONVERSION GRAPH

FIGURE 43



DISTANCE CONVERSION GRAPH

FIGURE 44

9-3 Perimeter Lighting-Optumization.

9-3.1. Mounting Height. With fixed position luminaires such as the roadway fixtures and illumination criteria based on horizontal footcandle (FC) measurement, it is to the designer's advantage to mount lighting units as high as feasible. Raising mounting height improves uniformity of lighting; it also allows greater spacing between poles and/or a greater distance that can be illuminated in front of the pole line. Current Air Force policy limits the height of perimeter poles in WSA's and AAA's to 35 ft maximum above ground. Sensor cable is located along the perimeter of these areas. Security police feel that longer poles, being in close proximity to the buried sensor system, will transit much higher intensity wind generated vibrations to the sensors and lead to an unacceptable level of nuisance alarms. The most efficient mounting height under the vertical FC constraints of the 1975 criteria (see par. 3-1.1) was approximately four ft. The requirement that equipment below 15 ft. be hardened effectively set the mounting height at 15 ft. above ground, which was also the maximum permitted at that time. The maximum span that could be illuminated per criteria at the 25 ft. mounting height would be approximately 35 ft. using a type III luminaire and 45 ft. with an IES type IV distribution. To project far enough in front of the pole line to illuminate a 55-60 ft. deep span, such as was required for the double fence configuration, requires a type IV luminaire mounted at 35 ft. minimum.

9-3.2. Luminaire Aiming. The beam distribution characteristics of the roadway luminaires are such that optimum performance for most applications will be obtained when the luminaire is oriented perpendicular to the pole line ("X" axis). This orientation corresponds to 90° horizontal in Corps of Engineers aiming format. The roadway luminaire is intended to be used in a single position vertically (0° vertically in C of E aiming format). There are no built-in provisions for vertical aiming other than minor adjustments (± 5°) to correct for pole misalignments. For the floodlight configuration that formed the basis of the 1975 design the optimum vertical aiming angle was determined to be 70°. Horizontal aiming angles were extended as low as 40° for the first 250 W floodlight and as high as 140° for the second to achieve a 100 ft. minimum pole spacing. Under a vertical FC constraint these angles are practical limits to horizontal adjustment. Increasing the angle between the two floodlights would yield only a negligible increase in pole spacing whereas the span illuminated in front of the pole line would decrease significantly. A mathematical analysis of effects of varying floodlight parameters has been prepared by the Office of Science and Research, Headquarters, SAC (Attachment 21). The effect of relaxing the mounting height constraint from 15 ft. maximum to 35 ft. maximum and changing to a horizontal FC criteria basis (ie. WSA at Malmstrom AFB) is that pole spacing can be increased from 100 ft to 160 ft. while maintaining uniformity under 3:1.

9-3.3. Beam Pattern. Roadway luminaires utilize both specially designed reflectors and prismatic lenses to achieve precise beam control.

All of the IES beam distribution patterns, except the type V, project most of their light laterally rather than tranversely, making them ideal for street lighting applications. The IES type III medium, semicutoff distribution proved to be most suitable for the 30 ft. depth associated with single fence perimeter lighting. This pattern is also the most common type used in commercial applications. IES type IV medium distribution pattern projects a larger proportion of its light energy in front of the pole than a type III unit would. The type IV unit was found to be more suitable for lighting the 55-60 ft. security zones characteristic of double fence configurations. Floodlights such as used in the 1975 design project their light energy in one general direction. Illuminating a narrow band parallel to the pole presents more of a problem particularly if low mounting heights are required.

9-3.4. Fence Shadow, Glare, Spill Light. When the pole line is set back from the perimeter fence, a portion of the light energy transmitted is blocked by the fence fabric, posts, barbed tape, etc, creating shadows or at least a measurable loss of light. Some of the light is reflected back into the protected area. If luminaires are mounted close to the fence (15 ft or less) at low mounting heights, the reflected light from the fence segments nearest the pole can be bright enough that guard personnel will have difficulty in discerning objects outside the fence. Providing a dark coating on the fence fabric will overcome this problem. The fence shadow effect will result in a somewhat poorer uniformity ratio although not apparently of a magnitude as to seriously diminish the effectiveness of TV surveillance. Increasing pole setback will reduce the glare and contrast problems but increase the range of fence shadow. Raising the mounting height however decreases glare, poor contrast, and extent of fence shadow. Uniformity ratio improves also. The best location for the luminaire is with the lense mounted directly over the fence. Shadows due to the fence are virtually nonexistent while vision through the fence is unimpaired. The only glare is from the concertina (barbed tape spiralled on top of the fence). There will be some spill light into the protected area whether roadway luminaires or floodlights are installed. Floodlights would require corner shields to control backlight. Backlight from roadway luminaires can be controlled with shields installed behind the refractor or more simply, with tape placed on the inside of the refractor. It should be noted that footcandle measurements, taken on a vertical FC basis, will always be zero directly under a roadway luminaire whereas the illumination level will be quite high as measured on a horizontal FC basis (or as seen by the eye).

9-3.5. Miscellaneous. The prime factors governing selection of luminaire wattage and beam type are the depth of the security zone in conjunction with maxmimum uniformity ratio requirement of 3:1. The maximum pole spacing possible is dependent on the size and beam type of a particular luminaire. The 400 watt type IV unit performed

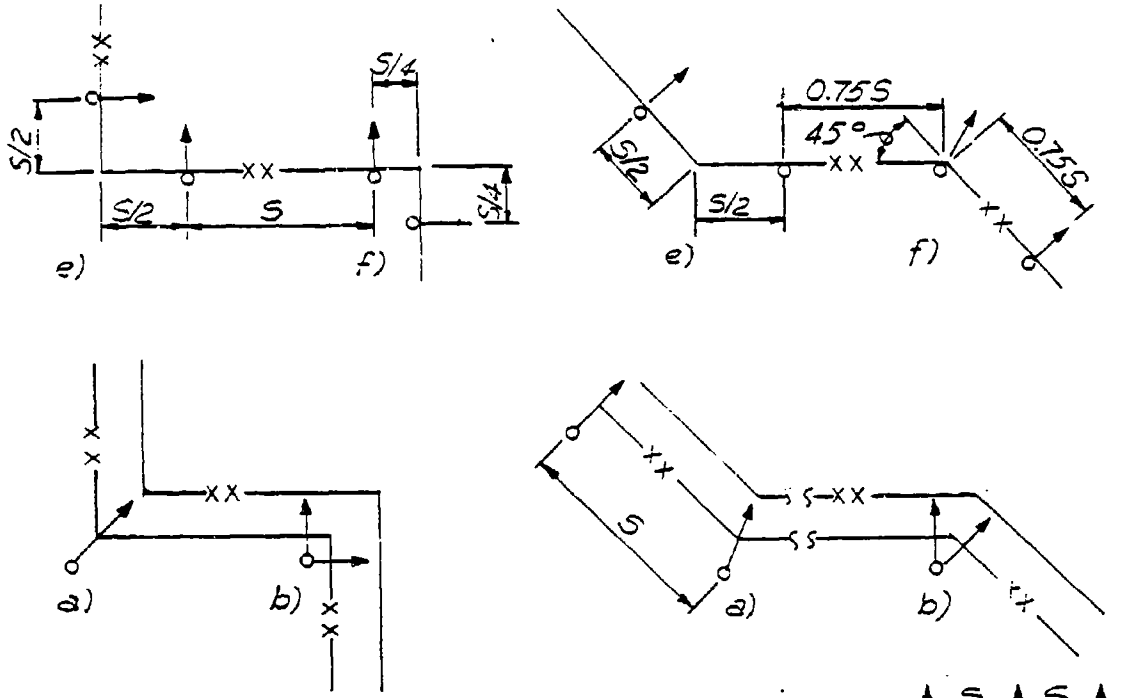
best for a double fence format with a security zone exceeding 50 ft. depth. The 250 watt, type III unit was more than adequate for the narrower 30 ft. zone of the single fence format, particularly at the somewhat conservative 100 ft. pole spacing.

9-4 Perimeter Lighting - Site Format.

9-4.1. Original Format. The 1975 design utilized two 250W high pressure sodium NEMA / x 5 floodlights mounted 15 ft. up on poles spaced 100 ft. apart for single fence lighting. Vertical aiming was 70°, horizontal 40° and 140°. The pole line was set back 20 ft. inside the perimeter fence. The double fence format was based on a single 400W, NEMA 7 x 6 aimed 90° horizontally, 65° vertically. Maximum pole spacing was 80 ft., pole setback 25 ft. Applicable definitives are series AD 71-03-01, sheets C1-C4.

9-4.2. Current Format - General. The present format represents a change in protective philisophy from glare projection toward the intruder to maximum visibility for closed circuit TV surveillance. Pole setback is influenced by the presence of the buried sensor system and the bases of TV cameras to be installed at a later date. Poles in WSA's should be approximately 3 ft. behind the perimeter fence and 6 ft. in AAA's. The luminaire must be centered over the (inner) fence and arm length adjusted as required. Computer tests were based on a 6 pole module which can be considerable repeatable for whatever length of perimeter fence may be involved. This procedure will give accurate results except at the ends of the fence and at corners. The format should be adjusted at corners per Figure 45. The illumination at the end of the pole line (at S/2) will be 1/2 of that between any two poles elsewhere, since at the end only one pole contributes to the total illumination. If it is desired to maintain the full spacing (S/2), a second luminaire, or a higher wattage luminaire, must be installed on the end pole.

9-4.3. Current Format - Single Fence. The zone to be illuminated under the single fence configuration is 30 ft. deep. A series of computer tests were made of various single fence configurations. The approved design utilizes a 250W high pressure sodium roadway luminaire having an IES type III, medium, semicutoff distribution and mounted 25 ft. above grade. Pole spacing is 100 feet. Luminaire aiming is 90° horizontal and 0° vertical. This format will yield an average horizontal footcandle level of 2.59 maintained at a uniformity of 2.92. This corresponds to 3.81 FC initial (maintenance factor = 0.68) vs the 2.0 FC required by criteria. Applicable definitives are series AD71-03-01, sheets C6 and C7. Applicable computer test is #T235B.



CORNER APPLICATIONS - Single Luminaire Configurations

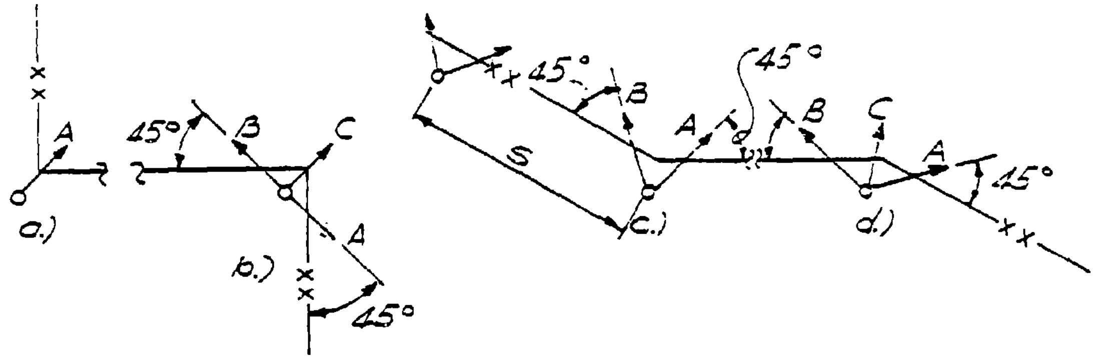
a. Inside Corner - install one floodlight bisecting the angle of the fences.

b. Outside Corner - install two floodlights, normal to the fence segment to the left and to the right of the pole, respectively.

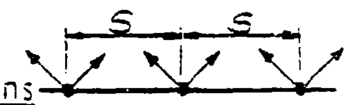
e. Inside corner - install one luminaire normal to each fence segment at 1/2 the standard spacing.

f. Outside corner - install one luminaire normal to each fence segment at 1/4 of the standard spacing for square corners; for obtuse angles between 90° and 180° determine the spacing between 25% and 100% of the standard spacing that corresponds to the particular angle and install one luminaire bisecting the angle

CORNER APPLICATIONS - PERIMETER LIGHTING



CORNER APPLICATIONS - Double Luminaire Configurations



a. Inside corner, right angle - install one floodlight bisecting the angle of the fences (also use for angles less than 90°).
b. Outside corner, right angle - install floodlights "A" & "B" at 45° angles with the fence and "C" bisecting the fence angle.
c. Inside corners, obtuse angle - install 2 floodlights at 45° angles to the fence (Note: arrangement 'a' may be used for angles up to 110°).
d. Outside corner, obtuse angle - install 2 floodlights at 45° angles with the fence and a 3rd ("C") bisecting the angle between these two floodlights ("A" & "B").

NOTE: The above or similar arrangements should be used at corners to insure minimum illumination levels will be provided. Spacing should not be less than indicated. Examples "a", "b", "c", and "d" are intended for floodlights or other luminaire type having a directed beam pattern that can be aimed as desired. Examples "c, d, e" and "f" are intended for roadway luminaires and similar units which distribute most of their illumination parallel to the pole line in both directions, and for which little or no adjustment in vertical aiming can be made. Roadway luminaires could be installed per examples "a" and "b"; however, there would be either more illumination than necessary in the clear zone ("b") or greater penetration of backlight inside the secure area ("a").

9-4.4. Current Format - Double Fence. The security zone for the double fence configuration is typically 55 - 65 ft wide. It consists of a clear zone extending 30 ft. beyond the outer fence plus a 25 - 35 ft. separation between the inner and outer fences. The luminaire must be centered over the inner fence. The format shown on Definitive Series AD71-03-01, sheets C7 and C8 utilizes a 400W high pressure sodium luminaire having an IES type IV, medium, noncutoff distribution. The luminaire is mounted 35 ft. above grade (measured from ground level at inner fence) and aimed 90° horizontally, 0° vertically. Maximum allowable pole spacing is 120 ft. This format yields 2.63 average horizontal footcandles and a uniformity ratio of 2.72 over a 60 ft. deep security zone. The corresponding average FC level when initially installed would be 3.87 FC. The applicable computer run is #T74A.

9-5 ENTRY CONTROL FACILITY (ECF) LIGHTING.

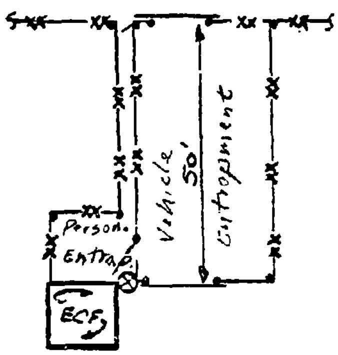
9-5.1. General Consideration. Entry facilities at WSA's and AAA's because of their special function and layout present unique design problems. Facilities at most WSA's are existing but show minimal standardization of layout. ECF's at some AAA's are existing, at others, the facilities are being built. As a result design essentially has to be implemented on a case by case basis. Areas of design to which a general optimized approach can be applied are limited. Since illumination criteria is on a horizontal footcandle basis, it is to the designers advantage to use the higher mounting heights of 35 or 40 ft. wherever feasible.

9-5.2. Site Format. A standardized entry control building design (Definitive Series AD27-05-02) has been developed for use of locations where no entry facility has previously been required or where an existing building is to be replaced. Two entry way configurations have been approved for use with the new building design - one having a 75 ft. deep vehicle entrapment area, the other with a 50 ft. deep area (see Figure 46). The first type of facility will be installed at weapons storage areas, the latter at alert areas. Sheets E2-E8 of Definitive Series AD 27-05-02 contain photometric data, application information, and lighting layouts pertaining to the above two types of areas. They also include as examples layouts for three different configurations of existing entry control facilities. Two acceptable lighting arrangements have been developed for each site layout - one based on high pressure sodium roadway luminaires having IES type III beam distributions, the other based on IES Type IV beam distributions. The lighting system is designed to be switched in three segments: entrapment lighting, background lighting (behind the building and outside the entrapment area), and building lighting.

9-5.3. Individual Luminaires. The footcandle distribution patterns characteristic of particular luminaires are shown on sheet E4 as an aid in selecting and locating luminaires at entry control facilities having configurations different than the examples shown. Isofootcandle curves are provided for 150 W, 250 W, and 400 W roadway luminaires having type III

JES

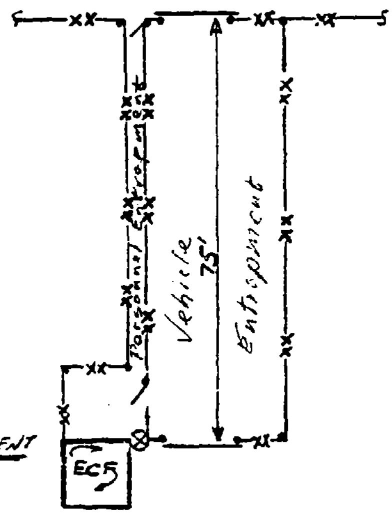
TYPICAL ECF SITE PLANS



NEW BUILDING "AAA"

50' CLEAR ZONE & ENTRAPMENT

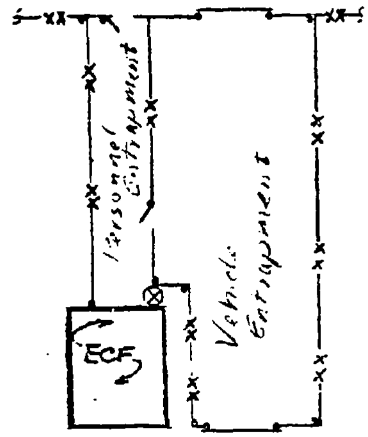
(NTS)



NEW BUILDING

75' CLEAR ZONE & ENTRAPMENT

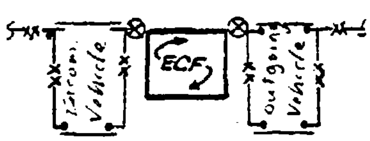
(NTS)



DETAIL "A"

CLEAR ZONE & ENTRAPMENT

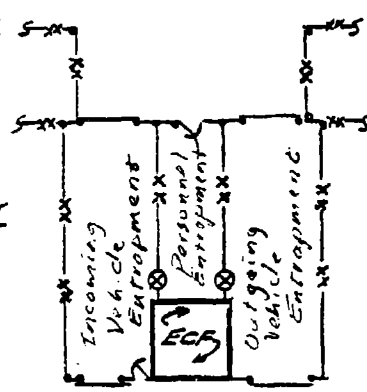
(NTS)



DETAIL "B"

CLEAR ZONE & ENTRAPMENT

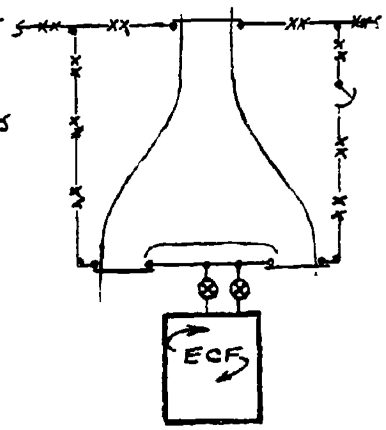
(NTS)



DETAIL "C"

CLEAR ZONE & ENTRAPMENT

(NTS)

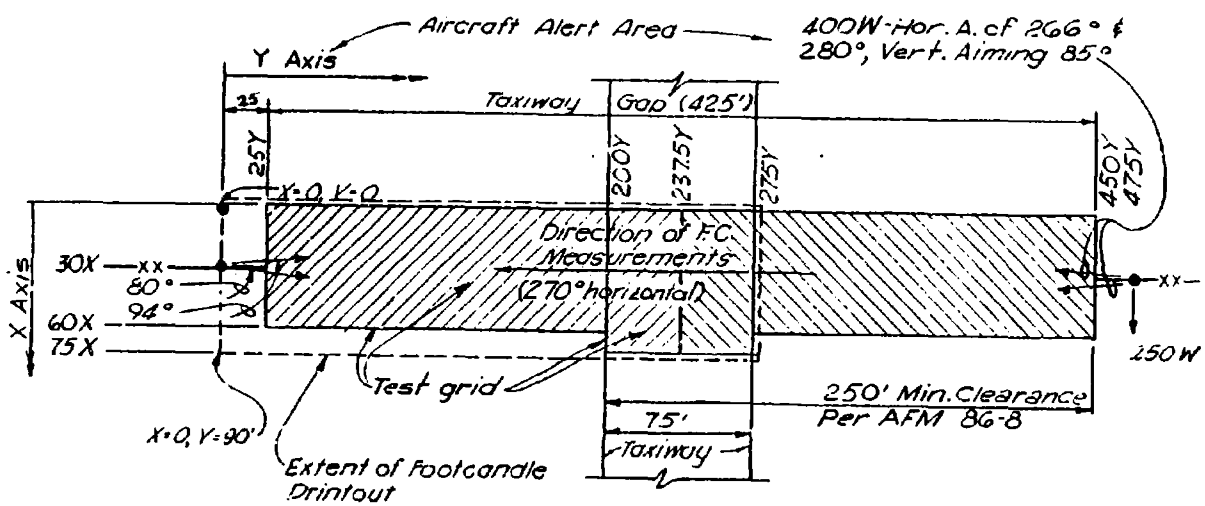


DETAIL "D"

CLEAR ZONE & ENTRAPMENT

(NTS)

FIGURE 46



TAXIWAY GAP

TYPICAL LIGHTING LAYOUT MODULE

Minimum lighting requirement in shaded area is 1.5 vertical foot candles.(maintained) at 3 feet above grade. A measurement of 1.5 F.C. obtained at anyorientation from 0^0 to 360^0 will be deemed to have satisfied the criteria.

Layout module meets minimum setback requirements of 250 feet from far edge of taxiways.

Lighting scheme shown on this sheet will satisfy criteria for a taxiway gap of up to 500 feet without adjusting horizontal or vertical aiming.

FIGURE 47

beam distribution and for 250 W and 400 W luminaires having type IV distribution. Given mounting height is 40 ft. Multipliers to apply to FC values are included if lower mounting heights should be desired. The type IV luminaires should be easier to manipulate in most cases.

9-6 TAXIWAY GAP LIGHTING

9-6.1. General Considerations. The gap in the perimeter fence across the taxiway of Aircraft Alert Areas presents a long narrow area to be illuminated. See Figure 47. Minimum criteria illumination levels have been established in terms of vertical footcandles. Under these constraints, narrow beam floodlights and relatively high aiming angles are appropriate.

9-6.2. Site Format. The minimum length of the gap across the taxiway gap is determined by the clearance criteria of AFM 86-8. No above grade structures are permissable in a 250 ft. wide band, measured from the far side of the taxiway. With a taxiway width of 75 ft this establishes a 425 ft. minimum taxiway gap. The depth of the area has been set at 75 ft. on the taxiway itself and 60 ft. for the remainder of the gap. The format illustrated on Sheet C5 of Definitive Series AD 71-03-01 will provide the criteria minimum illumination for gaps of up to 500 ft. This format utilizes two 400 W high pressure sodium floodlights having NEMA 4 x 4 beam spreads. They are mounted 20 ft. up on poles set back 25 ft. from the taxiway gap lighting zone. A relatively high vertical aiming angle of 85° is used. The two units on the right side (when looking out of the alert area) are aimed at 80° and 94° horizontally. The units on the opposite end of the gap are positioned at 266° and 280°. Provision for manual switching of taxiway lighting is included. Applicable computer trial numbers are TW18F and TW19D.

W. P. Shea, MROED-DC

D. L. Vollmer, MROED-DC

February 1978

APPENDIX A

MISCELLANEOUS ATTACHMENTS

LIST OF ATTACHMENTS

Item No.	SUBJECT
1.	Catalog Literature - Low Pressure Sodium Lamp Quality Outdoor Lighting.
2.	Catalog Literature - L.P.S. Lamp, North American Phillips Lighting Corp. (Norelco).
3.	Letter from Norelco Representative Concerning L.P.S. Lamp Restrike.
4.	Letter from SEPCO Lighting Representative Concerning L.P.S. Restrike and Lamp Mortality.
5.	Letter from Norelco Representative Concerning Chemicals Used in L.P.S. Lamp.
	Survey of Public Reaction to L.P.S. Lighting, City of Long Beach, California.
7.	Sources of L.P.S. Lighting Equipment
8.	Sample List of L.P.S. Installations and Studies.
9.	Article from Electrical Construction and Maintenance, January 1975: "Low Pressure Sodium Lamps: A Way to Conserve Energy"
10.	Article from Lighting Design and Application, April 1972: "A Second Look at Low Pressure Sodium".
11.	Article from Lighting Design and Application, December 1974: "Energy Conservation and Luminaire Dirt Depreciation".
12.	Article from Lighting Design and Application, April 1974: "Exterior Security Fence Lighting".
13.	Printout of Computer Program Used for Lighting Calculations
14.	Computer Program Abstract - Point to Point Lighting
15.	Printout of Computer Program Used for Economic Comparisons.
16.	Data on Night Lighting: Mean Daily and Annual Hours Required
17.	Disposal Instructions for Low Pressure Sodium Lamps
18.	Manufacturers Literature on Long Arc Xenon Lighting
19.	Printout of Computer Trial for a Selected Perimeter Lighting Configuration
20.	Printout of Computer Trial for a Selected Area Lighting Configuration
21.	Air Force Study of Optimization Techniques Applicable to Perimeter Lighting Using Floodlights

Advantages of Low Pressure Sodium

Developments and Improvements

The first practical LPS lamps, introduced commercially in 1932, produced about 50 lumens per watt. The development of glasses resistant to attack and discoloration by the sodium vapor, the re-design of the arc tubes, the development of new techniques and materials in reflecting the heat of the arc back into the arc; all have greatly improved the lamps. At present, the 180 watt lamp delivers approximately 183 lumens per watt and there is ample evidence that this will go higher.

Lamps of earlier design were limited in life because of sodium attack on glass and metal seals, glass absorbtion of the argon starting gas and the drift of the sodium to the cooler parts of the discharge tube. Modern lamps utilize a borate glass of special composition as a very thin, inner surface backed by lime glass to form the arc discharge tube. The borate glass withstands the attack by the sodium but would absorb moisture, hence the backing of lime glass. The borate glass does not discolor nor rapidly take up the argon gas. The present lamp life rating is 18,000 hours.

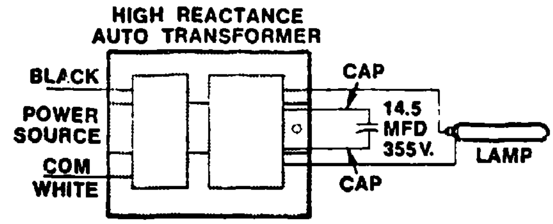
Older, U-shaped LPS lamps had the problem of sodium in the arc drifting away from the electrodes because the electrodes were much hotter than the remote end of the U-tube. The modern, smooth lamps have a tapered film of indium oxide on the inner surface of the outer glass tube. This film effectively equalizes the temperature, minimizes sodium drift and requires a smaller amount of sodium for lamp operation.

In this country, the earlier acceptance of the LPS lamps may have been slowed, in part due to the lack of American-made lamps. The earlier lamps, offered in commercial quantities, were made in England and Holland. They are now readily available here from stock through Quality Outdoor Lighting.

Technical development is increasing rapidly, especially in the field of illumination. Science has introduced a number of new light sources and, with computer aid, we have designed optical systems and luminaires for these new sources, providing our customers with new avenues of solving illumination problems on the streets and roads never before thought possible.

One of these new light sources is **Super-SOX** low pressure sodium lamp which is the most efficient light source known to man. It is presently playing an important role in increasing road safety, providing better area lighting and conserving energy.

The Facts . . . How It Works



Ballast Performance and Starting

The ignition in a **Super-SOX** low pressure sodium lamp is accomplished by means of gas discharge through a neon-argon gas mixture, in the inner arc tube, which also contains a quantity of free sodium. Because there is nothing to vaporize for ignition of the arc, these lamps are very reliable starters. The heat from the neon-argon discharge begins vaporizing the sodium, which continues to increase the light output, and after about 12 to 15 minutes the maximum output of the lamp is reached. Following start up from cold start, the lamp's light changes from red of the neon to yellow of the sodium discharge. Most importantly, if normal voltage is interrupted, there is very rapid restarting of the lamp when the line voltage is restored, because the temperature and pressure of the gas and sodium vapor needs little reduction to that required for re-start.

Thermal insulation is provided by the tube-within-a-tube construction of the LPS lamp and the evacuation of the air from the space between the tubes. This and the aid of the gas for the initiation of the arc, means that the ambient temperature has no practical effect on lamp starting. Also, this thermal insulation serves to make the operating lamp largely independent of the ambient temperature; the light output is essentially constant between −10°C (+14°F) and +40°C (+104°F).

The 260°C operating temperature of the surface of the arc tube is such that, if an interruption of the input voltage occurs, the arc temperature and pressure must reduce very little for the arc re-strike to take place. This minimal time for re-strike is a major safety feature in the use of the LPS lamps, avoiding an extended period without light.

The operating temperature of the surface of the arc tube is important for such tube whether it is a LPS lamp or a fluorescent, mercury, metal halide or high pressure sodium lamp. For any arc discharge lamp, the temperature of the coolest point on the arc tube controls the pressure of the vapor of the arc and that pressure, in turn, controls the amount of light which is developed by the arc. The tube of the LPS lamp operates at approximately 260°C (500°F) for maximum efficacy. Normally, this temperature is nearly uniform over the entire outer surface of the inner tube. This temperature is much lower than that for the mercury, metal halide and high pressure sodium lamps. The more

Quality Outdoor Lighting

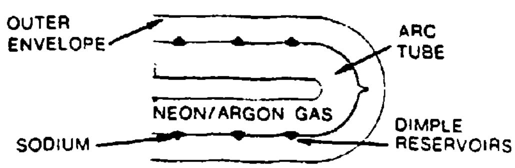
ATTACHMENT 1

moderate temperature of the LPS arc tube means that less infra-red energy is being released from the lamp and this limits any adverse heating effect on lamp sockets, wiring and other parts of the luminaire. Also, the result is a cleaner luminaire. (See report ERL-1102).

Ballasting requirements are similar to those for mercury or metal halide lamps, but the high voltage pulse or the helical heater coil required for high pressure sodium lamps is not needed for the LPS lamps. Therefore, the ballast design is simpler, with fewer maintenance problems and eliminates a possible source of radio interference.

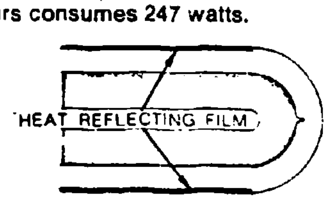
If there is under or over voltage on a LPS system, there will be a relatively flat response of light output of the lamps. This is due to the interaction of lamp current, voltage, power factor and efficacy, which results in only a modest decrease of light output with either a decrease or an increase in the system voltage.

Construction-Smooth vs. Dimpled Lamps



The dimpled lamps utilize indentations, spaced regularly along the outside of the inner, arc tube, as reservoirs for sodium. These serve to maintain the necessary level of sodium along the arc but require perhaps 10 to 20 times the amount used for the same size smooth lamp with film.

In the dimpled lamp reservoirs of sodium replenish the arc tube as the sodium vapor migrates. The reservoirs gradually empty during life. Although sodium migration is delayed it still occurs during the useful life of the lamp with a consequent fall in efficacy and, because arc voltage is higher in neon than in sodium, a progressive rise in lamp watts. A 180 watt lamp at 20,000 hours consumes 247 watts.



In **Super SOX** lamps the heat reflecting film on the jacket, although only light wavelengths thick, has a carefully designed and critically controlled change in thickness along the length of the lamp. This exactly balances the thermal and electrical gradients in the arc tube and maintains full sodium vapor light output along the tube throughout life. No significant watts rise through life and a more reliable life through eliminating the possibility of glass cracks at dimple stress points. A 180 watt **Super SOX** lamp at 20,000 hours consumes 187 watts.

High Luminous Efficacy and Lumen Maintenance

The **Super-SOX**, low pressure sodium lamp, produces up to 183 lumens per watt, which is considerably higher than either the clear mercury (57 lpw), metal halide (100 lpw) or the high pressure sodium (140 lpw) light sources of large size. The LPS life rating of 18,000 hours compares favorably with other sources, exceeding that for metal halide and for most sizes of the high pressure sodium lamps.

Super-SOX low pressure sodium lamp light output remains remarkably close to published ratings. Any decrease is modest and gradual over the life of the lamp. Lumen maintenance is 95% approx.

Color and Light

Within the very wide limits of the radiant energy spectrum, there is the comparatively narrow band of frequencies (380 to 760 nanometers) representing light energy. Any reference made to "color" or to a specific color is an indication of a specific wavelength, or a combination of wavelengths, within the range of light energy. Such wavelengths of light then enable us to see the color and brightness of an object or surface. Materials within the surface of an object or its finish, such as the pigments in a paint, reflect the selected wavelengths out of the light reaching the object. The limitation is that the wavelength desired must be in the light reaching the object if we are to have good color rendition.

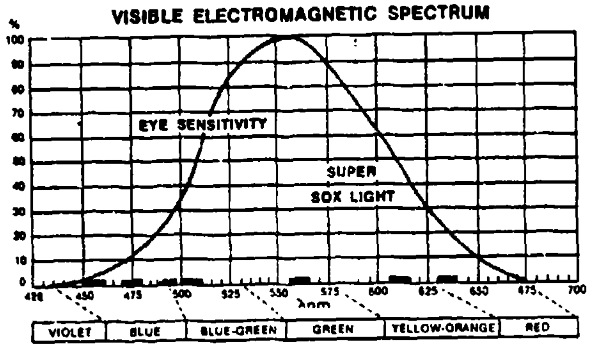
The LPS lamp, with all of its light output energy in very narrow wavelength bands near the center of the visible range, does not provide light for good color discrimination and there will be distortion of colors other than yellow.

The facts are that the spectral response characteristic of the human eye is such that maximum response is for light of approximately 555 nanometers in wavelength and the LPS light is largely in very narrow wavelength bands at 589 and 589.6 nanometers. The difficulty has been to attempt to link and interpret these facts.

Electrically, the benefits of the narrow band widths means that the energy is utilized where it will do the most good: in a narrow energy band to which the eye is extremely sensitive. The monochromatic yellow light and the high level of luminance prove most compatible, for example, with a television surveillance system. It does not provide for distinguishing colors or facial features but it does offer good clarity and picture detail.

The sensation that we call color and light is our psychological interpretation of certain portions of the electro-magnetic spectrum.

VISIBLE ELECTROMAGNETIC SPECTRUM



Spectral Emission Characteristics of High Intensity Discharge Sources

(Infra-red not included)

Principal Lines (Nanometers)

Mercury: 334.2, 365-366.3, 390.6, 404.7-407.8, 433.9, 434.7, 435.8, 491.6, 546.1, 577-579.

Scandium: 390, 436, 474, 508, 672

Sodium: 466, 498, 570, 584, 598, 614, 630-650

The visible radiation from the sodium lamp is yellow and largely monochromatic, consisting almost entirely of two special lines at 589.0 and 589.6 Nanometers. This closely corresponds to the peak response of the human eye (560.0 NM). Therefore, all light is produced in the most efficient area of eye response—the color amplifies contrast and is restful to the eye.

There have been claims and counter-claims but conservatively it appears that the very narrow band of LPS color has its advantages for roadway and area lighting. It may be argued that, in the case of relatively low level illumination, seeing deals largely with luminances and contrast—not with color.

A factor in the maintenance of lighting equipment is that a yellow light will attract a smaller number of insects than a white light of equal candlepower and a lower candlepower will attract fewer insects. Therefore, the LPS lamp, with low luminance and yellow color, is to be preferred.

Luminance

The arc tube luminance (photometric brightness) of the **Super-SOX** low pressure sodium lamp is 10 cd/cm², an extremely low value compared with 450 cd/cm² for the clear, high intensity mercury lamps and 1,000 cd/cm² for the clear, high pressure sodium lamps. This results in a low-glare source for the LPS and permits maximum visual capabilities.

Light control of present luminaires for LPS lamps is such that there is considerable light delivered to the roadway shoulders and median strips. Motorists have been very much aware of this and a majority, in a Chicago survey, have expressed approval. A majority of the motorists were reported to like the amount of light, the lower glare and the visibility of the signs and lane-separating stripes. Many motorists express pleasure in the "golden glow" of the LPS light and many feel that the signs located along the roadway are more attention-getting than when lighted with mercury lamps.

It is reported that mercury lighting installations must have 90% higher levels of illumination than sodium light for the same visibility distance. Results of investigations comparing the apparent brightness of light color on the perceptibility and on the glare and brightness impressions of the road user can be summarized by the comparison of high pressure mercury, phosphor-coated lamps with that of sodium lamps: a) Both from visibility test on existing lighting installations and in an open-air laboratory, as from threshold value measurements indoors, it has been found that in order to obtain the same visibility, the luminance of the background with improved color mercury lighting must be at least 1.5 times higher than with sodium light; b) The luminance of the luminaire in the direction of the eye of the road user may be almost 1.5 times higher with sodium light than with improved color mercury lighting without increase in discomfort glare; and c) For the same impression of road surface brightness for the road user, the road surface luminance with color improved mercury lighting must be 3 to 4 times higher than for sodium light.

Super-SOX luminaires result in lower cost for many street and area installations because of the higher efficacy of the LPS lamps, fewer luminaires and poles and reduced installation, owning and operating costs. The combination of the **Super-SOX** lamp and luminaire provides better illumination uniformity on both wet and dry road surfaces.

Traffic Guidance and Security

The additional light which LPS luminaires distribute to roadway shoulders makes it easier for the motorist to distinguish the location of entrances and exits. The distinctive color of the LPS is being used successfully to distinguish major intersections or entire sections of roadway, such as by-pass arteries around a city. The color is also very distinctive in use as security lighting, delineating an outline or area and discouraging intrusion and vandalism.

SUPER SOX PERFORMANCE

Production of light

The passage of an electric current through the vapor of sodium metal causes the sodium atoms to emit the well-known yellow light characteristic of sodium discharge.

Starting and operation

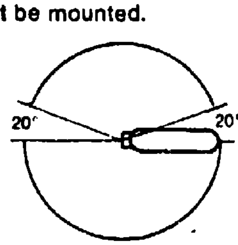
When a sodium lamp is first switched on the normal mains voltage is not sufficient to cause a discharge between the electrodes, and the control gear is designed so that a sufficiently high voltage, up to 550 volts, is available. As the lamp runs up, the arc voltage after rising slightly is reduced to a value where the nominal lamp wattage is achieved. At the instant of starting, the discharge takes place in the argon gas which in turn initiates a discharge in the neon gas with which the arc tube is also filled. The heat developed by the discharge in the neon gas gradually vaporizes the sodium metal.

Fast restarts

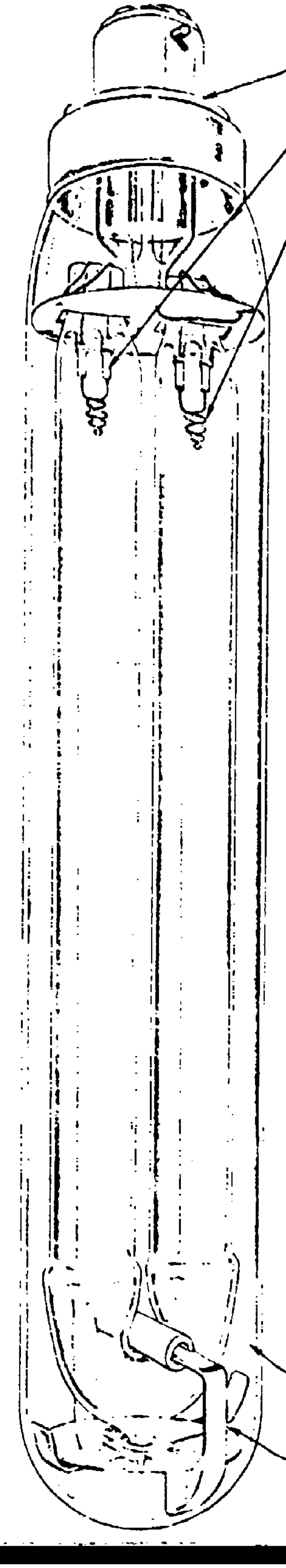
SuperSOX lamps restart faster than any other type lamp. Start immediately on switching and runs up quickly to full brightness. Starts and runs at any temperature as low as −58°F. Restarts immediately at restoration of power, even if only momentary break. **Super SOX** lamps are relatively insensitive to marked variations in power supply.

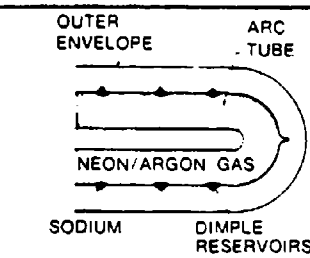
Operating position

The shaded portion of the diagram shows the position in which the lamp **must not** be mounted.



Super SOX lamps made differently for longer life, higher lumen output and trouble free operation.





DIMPLE CONSTRUCTION

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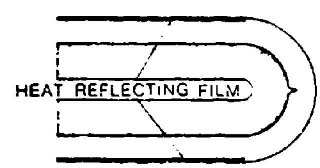

TAPERED FILM CONSTRUCTION

In Super SOX lamps the heat reflecting film on the jacket, although only light wavelengths thick, has a carefully designed and critically controlled change in thickness along the length of the lamp. This exactly balances the thermal and electrical gradients in the arc tube and maintains full sodium vapor light output along the tube throughout life. No significant watts rise through life and a more reliable life through eliminating the possibility of glass cracks at dimple stress points. A 180 watt Super SOX lamp at 20,000 hours consumes 187 watts.

COLOR AND LIGHT

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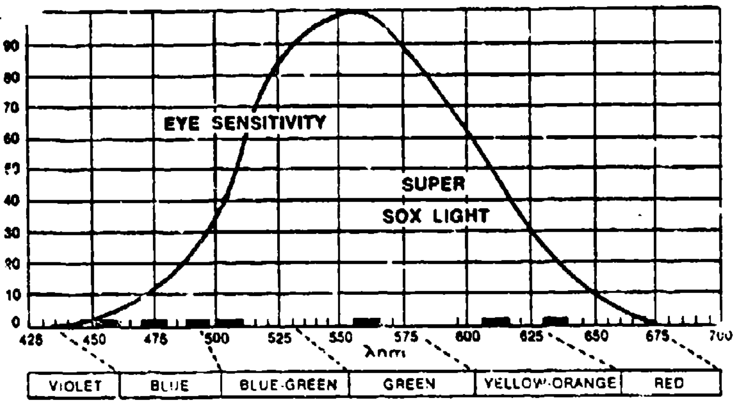
VISIBLE ELECTROMAGNETIC SPECTRUM



Spectral Emission Characteristics of High Intensity Discharge Sources

(Infra-red not included)

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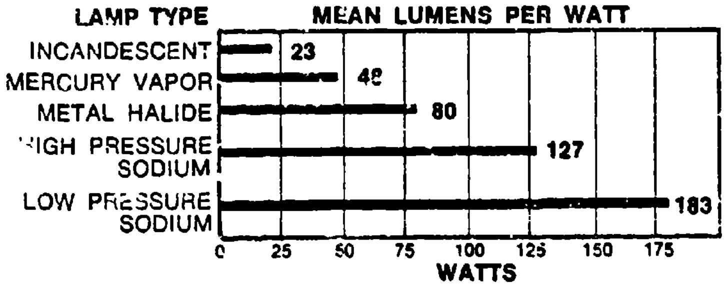
HIGHEST LUMENS PER WATT

No matter what anyone else tells you, the low pressure sodium **Super SOX** lamp is the most efficient light source known to man. None of the recent advantages in the field of high pressure discharge lamp has reduced the importance of the low pressure sodium lamp as the supreme source in applications where the highest possible luminous efficacy is the decisive factor influencing choice. The **Super SOX** low pressure sodium lamps are up to eight times more efficient than incandescent. They are four times more efficient than mercury vapor lamps. Up to two and one half times more efficient than metal halide lamps and even 46% more efficient than high pressure sodium lamps, the second most efficient light source made by man.



LIFE

A satisfactory life and the absence of early failures is a primary characteristic of **Super SOX** sodium lamps. Ultimate failure generally results from exhaustion of the emissive materials and to a secondary degree from absorption by the glass of the argon gas. The rated average life of all types of sodium lamps is 18,000 hours. Lumen maintenance is 95% approx.

WATTS

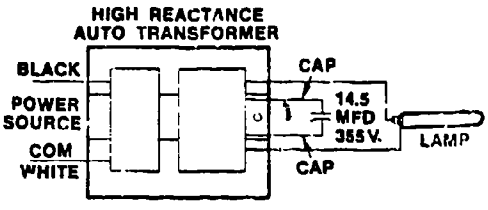
The lamp watts through life for a **Super SOX** tapered film lamp produces a constant wattage operation whereas other types of lamps exhibit a marked rise in watts during life.

CONSTRUCTION

Not all Sox lamps are of similar construction. The new **Super SOX** low pressure sodium lamp is an entirely new concept in which the conventional dimple type construction has been eliminated. The new lamp utilizes a coating on the outer glass envelope with a heat reflecting film relatively thick at the U bend end and tapering off to almost one third as thick at the electrode end. The film has the property of absorbing almost no visible light, so there is no reduction in light output. Also with all the sodium initially at the U bend end, much closer control of lamp is possible. This produces a maintained brightness over the whole lighting length of the lamp life.

BALLAST DESIGN

Trouble free operation, long lamp life, simple ballast design. When you vary the line voltage ±10% your wattage output will vary only ±4%.



Dual wattage ballast design.
55 watt ballast will also operate a 35 watt lamp.
180 watt ballast will also operate a 135 watt lamp

SUPER SOX COST SAVINGS

Here's how three different lamps compare in efficiency, power consumption and lighting cost. (Based on the industry average of 54 lighting fixtures per mile of interstate highway.)

When comparing three different light sources in efficiency, power consumption, and lumen output, based on the industry average of 54 luminaires per mile of interstate highway, converting to low pressure sodium would save over $1,000.00 per mile per year in operating lamp cost and over 50,000 Kilowatts per mile per year.

Lamp Type	Number of Fixtures	Efficiency Lumens/ Watt	KW Con-sumed/ Mile	Annual Lamp Operating Costs*
low pressure sodium (SOX 180W)	54	183	9.72	$ 850.00
high pressure sodium (400W)	54	117	21.5	$1,890.00
mercury vapor (400W)	54	54	21.5	$1,890.00

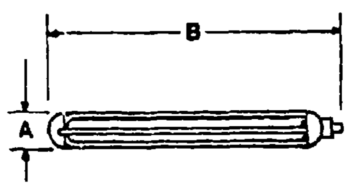
*in dollars per mile.

Ordering Information

Super SOX L.P.S. Lamp Information / Dimensions

Lamp Watts	Bulb	Base Design Bayonet	Ordering Abbreviation	Rated Aver. Life, Hrs.	Approximate: Lumens Initial	Mean	Description See below	A Bulb Dia.	Light Center Length	B Max. Overall Length	Std. Pkg. Qty.
35	T-16	B.C.	SOX 35	18000+	4600	4508	1, 2, 3, 4, 5, 6, 7, 8, 9 and 10	2 1/8	6 3/4	12 3/16	12
55	T-16	B.C.	SOX 55	18000+	7650	7497		2 1/8	9	16 3/4	12
90	T-21	B.C.	SOX 90	18000+	12750	12495		2 11/16	11	20 3/4	6
135	T-21	B.C.	SOX 135	18000+	22000	21560		2 11/16	16	30 1/2	6
180	T-21	B.C.	SOX 180	18000+	33000	32340		2 11/16	22 5/8	44 1/8	3

1. Rated average life is the life obtained on the average, from large representative groups of lamps in laboratory tests under controlled conditions at 5 or more burning hours per start. It is based on survival of at least 50% of the lamps and allows for individual lamps, or groups of lamps, to vary considerably from the average.
2. Performance may not be satisfactory unless operated within specified burning positions. See operating position page 6.
3. Starting supply voltage must be held to 10 volts of rated line voltage.
4. Lamps will start down to −58°F.
5. Suggested maximum capacity temperature: 210°C.
6. Requires a ballast specified or approved for Sox lamps. 35 watt ballast will also operate 55 watt lamp. 135 watt ballast will also operate 180 watt lamp.
7. Color: not on Black Body Locus but monochromatic at 3,896 nm.
8. C.I.E. chromaticity: x = .575 y = .425
9. Warm-up time: 50% full 7 minutes; 100% 15 minutes.



10. ELECTRICAL CHARACTERISTICS:

Nominal lamp watts:	35W.	55W.	90W.	135W.	180W.
Nominal lamp volts:	70	109	112	164	240
Nominal lamp current (amps):	0.6	0.6	0.95	0.95	0.91
Starting line current less than line operating current:					
Nominal lamp starting volts R.M.S.:	390	410	420	520	600

... there's no substitute for Quality
Quality Outdoor Lighting • Northbrook, Illinois 60062 • (312) 498-6540

Printed in U.S.A. 6

Norelco®

SOX

LOW PRESSURE SODIUM LAMPS FROM NORTH AMERICAN PHILIPS.

The modern generation of low pressure sodium lamps (SOX) incorporates more than forty years of research and development in lamp technology.

With efficiencies up to 183 lumens per watt; SOX are the most economic lamps available in the world for public and industrial applications. Coupled with this technological breakthrough in efficiency, SOX lamps maintain their initial lumen output throughout a rated life of 18,000 hours.

All SOX lamps are of similar construction. A borate coated, sodium resistant "U-Bend" discharge tube is enclosed in an integral vacuum jacket. This vacuum jacket is internally coated with indium oxide to maintain optimum operating temperatures. (See figure No. 1)

The spectral light output of a SOX lamp (589.0 nm.) closely corresponds to the peak response of the human eye (560.0 nm.). This feature of low pressure sodium lamps economically creates improved nighttime visibility. (See figure No. 2)

Whereas some lamps are limited in their applications due to weather conditions, SOX lamps ignite and operate normally irregardless of ambient temperatures. No rise in ignition voltage or loss in light output is ever experienced by the influence of temperature variations.

FEATURES

- **Highest Efficiency of Any Commercially Available Lamp (Max. of 183 Lumens Per Watt)**
- **Optimum Lumen Maintenance (100%)**
- **Long, Reliable Life (90% Survival at 10M Hours)**
- **Low Current Operation**
- Low Surface Brightness
- Low Operating Temperature
- No UV Output
- Non-Insect Attracting
- High Performance in Fog/Mist Conditions
- Sodium is a Non-Polluting Element
- Suitable for Operation with Photo Control
- Overall Reduction in Maintenance Costs

APPLICATIONS

- Highway Lighting
- Traffic Intersections
- Railway Yards, Harbors, and Docks
- Railway Crossings
- Pedestrian Crossings
- Flood Lighting
- Industrial Lighting
- Quarries and Mines
- Specialized Quality Control Applications
- Shipyards
- Tunnels and Underpasses
- Security Lighting

ATTACHMENT 2

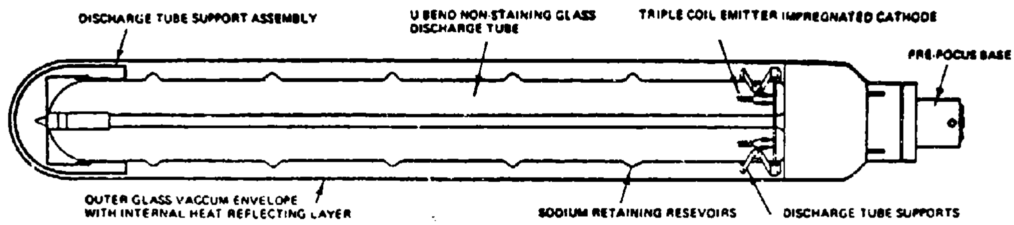
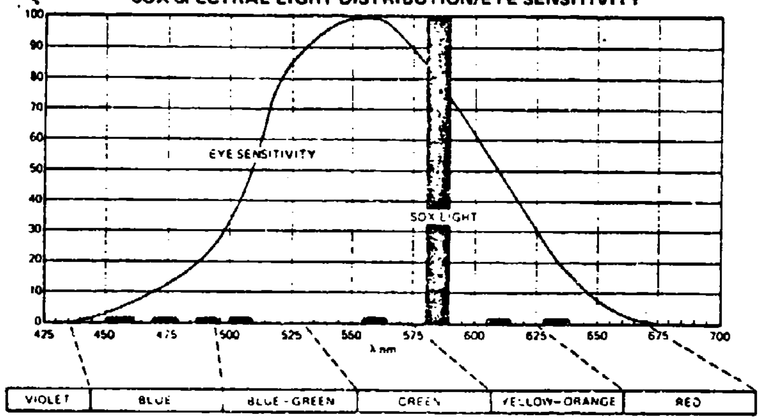


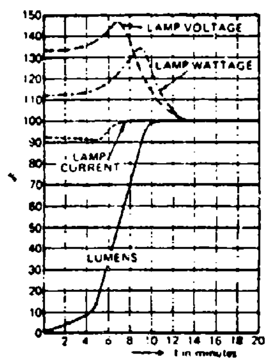
FIGURE 1

FIGURE 2

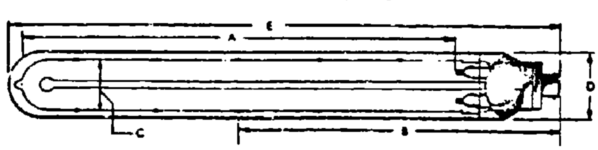
SOX SPECTRAL LIGHT DISTRIBUTION/EYE SENSITIVITY



LAMP PERFORMANCE DURING STARTING PERIOD

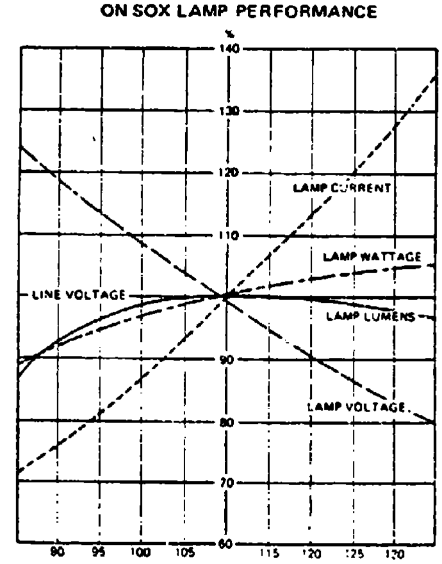


APPROXIMATE DIMENSIONS OF LAMPS



Lamp type	35 W	55 W	90 W	135 W	180 W
A (in)	7 9/16	12	15 7/8	25 7/16	38
B (in)	7 1/4	9 9/16	11 1/2	16 3/8	23
C (in)	1 7/16	1 7/16	1 13/16	1 13/16	1 13/16
D max. (in)	2 1/8	2 1/8	2 11/16	2 11/16	2 11/16
E max. (in)	12 3/16	16 3/4	20 3/4	30 1/2	44 1/8

EFFECT OF LINE VOLTAGE VARIATION ON SOX LAMP PERFORMANCE



CHARACTERISTICS OF SOX LAMPS

Lamp designation	Starting voltage V	Lamp voltage V	Lamp current A	Luminous flux[1] lm	luminance cd/cm^2	Starting period[2] min	Weight
SOX 35 W	380	70	0 600	4650	10	7	8 oz
SOX 55 W	410	105	0 590	7700	10	7	13 lbs
SOX 90 W	420	115	0 940	12500	10	9	1 lb 3 oz
SOX 135 W	575	160	0 950	21500	10	9	1 lb 14 oz
SOX 180 W	575	245	0 910	33000	10	9	2 lb 6 oz

1) After 100 burning hours

2) The number of minutes after which the lamp has reached 80% of the max. luminous flux.

ORDERING AND PACKAGE DATA

Lamp designation	Zip code	Ordering abbreviation	Packing unit: Qty	Weight lbs	Dimensions in			Volume ft^3
SOX 35 W	AW 21	SOX 35	9	11	12 3/4	12 3/4	18 1/8	1.73
SOX 55 W	AW 22	SOX 55	9	15	12 3/4	12 3/4	22	2.08
SOX 90 W	AW 23	SOX 90	9	22	14	14	26 3/16	2.96
SOX 135 W	AW 24	SOX 135	9	29	14	14	39 3/16	4.41
SOX 180 W	AW 25	SOX 180	9	44	16 9/16	16 15/16	53 3/4	8.[illegible]

SOX LAMP LIFE WATT CONSUMPTIONS

LAMP	HOURS 100	2000	5000	10,000	18,000
SOX 35 W	36 W	37 W	36 W	41 W	44 W
SOX 55 W	53 W	57 W	58 W	65 W	62 W
SOX 90 W	90 W	93 W	100 W	116 W	122 V
SOX 135 W	130 W	140 W	149 W	173 W	178 W
SOX 180 W	176 W	187 W	211 W	220 W	241 W

August 15, 1975

Mr. R. S. Bruns
P.O. Box #5456
Greenville, South Carolina 29606

Dear Mr. Bruns,

Re: Security Lighting/Charleston, S.C. Naval Facility

I have contacted our Laboratories with a view to obtaining more specific data regarding the hot re-ignition characteristics of low pressure sodium lamps but as mentioned, this will take some time to obtain. Based on experience, I would advise the following in the interim:

1. 35 and 55 watt lamps will re-ignite immediately following a power drop-out with a reliability factor of plus 95%.

2. 90, 135 and 180 watt lamps will re-ignite immediately following a power drop-out with a reliability factor of plus 75%.

3. Lamps that do not re-ignite immediately will strike within a maximum of 2 minutes.

4. The amount of light produced when lamps re-ignite will be dependent upon the duration of outage. In general if power is restored within 30 seconds, those lamps which re-ignite immediately will produce 90% plus of their maximum light output.

5. Normal "run-up" time for a cold lamp to full output will be a maximum of 10 minutes.

Recently I had the occasion to visit a 224 floodlight installation (SOX 180W lamps in SNF027 fixtures) at Port Elizabeth, N.J. In the course of our inspection power was cut and restored in approximately five minutes. All lamps visible from our point of viewing re-struck immediately and with sufficient output to

Letter from representative of North American Philips Lighting Corp.

make work in the area possible.

The enclosed literature covers the range of Norelco low pressure sodium lamps and fixtures; but, should you have specific questions please don't hesitate before contacting me. Because of the nature of the project you are working on, and in order to minimize delays in communication, it is felt that we can best serve you directly from Hightstown, rather than via our Atlanta Office.

I would call your particular attention to the enclosed documentation on the catenary system of lighting. Based on your advise I would suggest this would be the most economic and light technically correct approach to adopt.

When and if you feel a meeting with yourself and/or the Naval engineers is required, arrangements can be made to suit your convenience.

Personally I look forward to hearing from you and working with you to resolve this highly interesting lighting project.

Yours sincerely,

Robert A. Lewis
Corporate Commercial Engineer

RL:dm
Enclosures

cc: A. L. Merken
J. A. Donmoyer
R. Ricchiuti (For Information Only)

1 2 8
(navy)

July 31, 1975

Department of the Navy
Southern Division
Naval Facilities Engineering Command
2144 Melbourne St.
P.O. Box 10068
Charleston, S.C. 29411

Code 404
(C.T. Paysinger)

Subject: Series 4000 Luminaire for Low Pressure Sodium

Gentlemen:

Enclosed is the information which you requested on our Series 4000 Low Pressure Sodium Luminaire. Our catalog sheet describes the fixture size, material, beam spreads and other construction features. The candlepower distribution curves provide the information on maximum candlepower, lumen efficiency and other photometric data.

The lamp information is provided on the North American Phillips (lamp manufacturer) Lamp Data Sheet. This sheet provides lamp sizes, dimensions, lumen output, power consumption thru lamp life. The lamp has a rated life of 18,000 hours with 90% survival at 10,000 hours. The lamp lumen maintenance is 100% over life of the lamp. This burning position for the 90 watt, 135 watt, and 180 watt lamps is horizontal plus or minus 20% of horizontal.

The latest information from the lamp manufacturer is that 90% of the lamps will restrike immediately with interruptions up to 5 minutes. The other 10% will take up to 58 seconds to restrike. If the line voltage is 10% less than ballast rating the restrike times will be the same but the lumen output will be less than full intensity and will take time to come back to normal full intensity.

ATTACHMENT 4 (1)

I hope that we have provided all of the answers to your questions. If not, or if you have further questions please let me know. At this time I would also like to offer any assistance that we can provide in helping to layout any project that you have or review your designs.

Very truly yours,

SEPCO LIGHTING DIVISION
Connecticut International Corp.

Frank Locke
Sales Engineer

FL/bak

NORTH AMERICAN PHILIPS
LIGHTING CORPORATION

HIGHTSTOWN, NEW JERSEY 08520

TELEPHONE: (609) 448-4000

February 4, 1975

Mr. Richard Anderson
NAPLC
255 W. Carob Street
Compton, California 90220

Dear Mr. Anderson

With reference to questions raised by the Bechtal Corporation I would confirm the following points relating to sodium lamps.

Low pressure sodium vapor lamps (SOX) supplied by the North American Philips Lighting Corporation do not contain mercury in any form. The only elements present in the lamp discharge tube are sodium and a small quantity of neon-argon mixture (99%-1%), the function of which is to initiate the discharge. The tungsten electrodes are impregnated with a rare earth oxide to assist in ignition.

Conversely, high pressure sodium lamps contain sodium in the form of a sodium - mercury amalgam. In this case, xenon is normally used as a "starter gas."

SOX lamps can be safely employed in lighting installations where there are severe restrictions on the presence of mercury such as in proximity to nuclear reactors.

With kind regards,

Yours sincerely,

Robert A. Lewis
Corporate Commercial Engineer
Discharge Lamps & Fixtures

RAL/sv
cc: G. Gedney
L. Pintak
B. Yates

ATTACHMENT 5 5-1

Survey
results

SURVEY OF PUBLIC REACTION TO LOW PRESSURE SODIUM LIGHTING. CITY OF LONG BEACH, CALIFORNIA

Residential Test Installation

Replacement of 175W mercury vapor with 55W LPS

Public response:

1.	Do you approve of the new light fixtures in appearance?	85% Yes
2.	Do you find the new light color objectionable?	74% No
3.	Do you prefer the previous mercury vapor lights?	72% No
4.	Is visibility as good with the new lights?	76% Yes
5.	Even if there were some objection to the new type lights, do you feel the energy saving justifies the installations?	89% Yes

Power consumption reduced by 70%

Business Street/Shopping Center Installation

Replacement of 700W mercury vapor with 180W LPS

Public response:

1.	Do you approve of the new lights in appearance?	96% Yes
2.	Do you find the new light color objectionable?	88% No
3.	Do you [illegible] fer [illegible] previous mercury vapors	80% No
4.	If your customers have made comments on the new lights, have they been generally favorable?	81% Yes
5.	Even if there w[illegible] some objection to the new type lights, do you feel the energy saving justifies the installations?	92% Yes
6.	Do you feel the new type lights have affected business in the shopping center?	92% No change or favorably

Lighting levels up approximately 10% and power consumption has been reduced by 74%.

ATTACH. 6

SOURCES OF LOW PRESSURE SODIUM LIGHTING EQUIPMENT

A. Luminaires

1. Architectural Area Lighting Co.
   Subsidiary of LCA Corp.
   1 13901-13 South Carmenita Rd.
   Sante Fe Springs, CA 90670

2. American Elecrric ITT
   Southhaven, MS 38671

3. Benjamin Electric Mfg. Co.
   P. O. Box 180
   Spartan, TN 38583

4. Devine Lighting
   Division of LCA
   4546 East 11th St.
   Kansas City, MO 64127

5. Guth Lighting
   Division of Sola Basic
   P. O. Box 7079
   St. Louis, MO 63177

6. J.H. Spaulding Co.
   Division of LCA/Whiteway
   3731 Dirr Street
   Cincinnati, OH 34223

7. Lustra Lighting Corp.
   180 Manor Road
   East Rutherford, NJ 07073

8. Natale Machine & Tool Co.
   Broad St. & 13th St.
   Carlstadt, NJ 07072
   (35W Floodlight only at present)

9. North American Philips (Norelco)
   Lighting Corporation
   Hightstown, NJ 08520

10. Omega-Lite
    3715 Woodmont
    Toledo, OH 43613

11. Quality Outdoor Lighting
    3535 Commercial
    Northbrook, IL 60062

12. Red Dot Lighting
    L E Mason Co.
    98 Business Street
    Boston, MA 02136

13. Sepco Lighting Division
    Connecticut International Corp.
    9 Britton Road
    Bloomfield, CT 06002

14. Streetlighting Equipment Company
    3123 61st Street
    Woodside, NY 11377

15. Stonco Lighting Division
    Keene Corporation
    2345 Vauxhall Road
    Union, NJ 07083

16. Trimblehouse Corp.
    P. O. Box 726
    Norcross, GA 30071

17. Verd-A-Ray Corp.
    615 Front Street
    Toledo, OH 43605
    (Services as marketing arm of Norelco)

18. Voight Lighting Industries, Inc.
    135 Fort Lee Rd.
    Leonia, NJ 07605

B. Ballasts*

Advance Transformer Co.
2950 Western Ave.
Chicago, IL 60618
(Norelco lamps)

Jefferson Electric Co.
Division of Litton Systems, Inc.
Bellwood, IL 60104
(GEC lamps)

C. Lamps*

General Electric Co. Ltd. of England
(Available from Quality Outdoor Ltg.)

Phillips Corporation of Holland
(Available from other companies listed under "A".)

*NOTE: Lamps are readily interchangeable. There is no adverse effect on either ballasts or luminaires.

SAMPLE LIST OF LOW PRESSURE SODIUM INSTALLATIONS AND STUDIES

A. Installations of L.P.S. Lighting.

Elizabeth Port Authority Marine Terminal
New Jersey - 224 Norelco 180W units

State of Illinois, Division of Highways
Expressway Lighting on Interstate 55
1971, 180W units replaced 400W mercury vapor

Hawthorne, California
Roadway Lighting, November 1974
135W Norelco

Parking Lot, Penn Harris Motor Inn
Camp Hill, Pennsylvania

New York City
Highway Lighting, 1971

Energy Research & Development Administration
(ERDA), Germantown, Maryland
Roadway & Parking Lot Lighting
135W Units, June 1975

B. Organizations that have Studied L.P.S. Lighting.

Navy Public Works Center
Code 423
P. O. Box 113
San Diego, Calif. 92136

Southern Division
Naval Facilities Engineering Command
P. O. Box 10068
Charleston, S. Carolina 29411

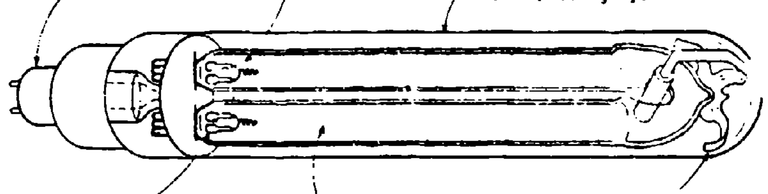
LPS being considered for Naval Air Stations at Charleston, S.C. and Jacksonville, Florida)

C. Miscellaneous - Other Reported Installations or Studies.

Robbins AFB
A.F. Logistics Command
Chicago Naval Air Station
Bronx Whitestone Bridge, New York City - 1974
Port Elizabeth, New Jersey

Attachment #8

CONSTRUCTION FEATURES of typical U-shaped LPS lamp. Overall length of a 180-watt lamp is 44 in., and its diameter is almost 3 in.



By WILLIAM A. WEIBEL
Lighting Consultant, P.E., F.I.E.S.

Low-pressure-sodium lamps: a way to conserve energy

Improvements in lamp design and concern over rising fuel costs have stimulated a renewed interest in this unique source of light.

THE SPOTLIGHT has centered on the development of the high-pressure-sodium lamp during the past decade; however, steady progress was also being made in improving the efficiency and usefulness of the *low-pressure*-sodium (LPS) lamp, which first appeared during the early 1930s.

The importance today of cutting energy wherever possible has stimulated new interest in the LPS lamp. This article is intended to review its characteristics, principle of operation, construction, and possible uses.

Characteristics and operation

Light is produced in the LPS lamp by the passage of an electric current through sodium vapor. The principle is very similar to that of other high-intensity discharge sources (mercury-vapor, metal-halide, high-pressure-sodium); however, the LPS lamp differs in essential details of operation and light-output characteristics that make it unique.

As with other arc-discharge lamps, light output of the LPS lamp is critically dependent upon the arc-temperature and vapor pressure. Initially, the lamp utilizes one or more starting gases (neon, argon, xenon and helium) within the discharge tube to initiate an ionization path for the current flow, since sodium is in solid form below 98C and has a very low vapor pressure. As ionization and temperature increase, the sodium vaporizes. Initially, the light has the characteristic red color of neon; but as temperature and pressure increase and the sodium vaporizes fully, the color changes to yellow.

Starting time of the LPS lamp is 10 to 15 minutes, depending upon lamp type, size, and application. It is not affected by ambient temperatures between -50C and +40C, and when the lamp reaches full output, ambient temperatures have an insignificant effect on operating characteristics because of the insulation provided by the vacuum within the space between the discharge tube and the outer bulb.

A relatively low temperature of 270C is maintained in the discharge tube while the lamp is operating. Because of this, the restart period of the LPS lamp after a power interruption is only about one minute—the time for temperature and pressure to decrease to starting conditions. (Other discharge lamp types, such as mercury, with much higher operating temperature and pressure, have a restart time of three to seven minutes.)

Most higher-wattage LPS lamps should be operated with the major, longitudinal axis of the lamp at or within 20 deg of the horizontal. This positioning assures a more uniform temperature in the discharge tube and distribution of the sodium for optimum light output and lamp life.

The output of the LPS lamp is concentrated almost completely in two narrow bands of wavelength, at 589.0 and 589.6 nanometers* (yellow region). Since other wavelengths in the visible region of the electromagnetic spectrum essential for good color rendition are lacking, colors other than yellow that are present in an object will appear distorted under the LPS lamp. However, this monochromatic light emission occurs very near to the most-sensitive point of response (555 nanometers) of the human eye. This means a very high utilization of muscular and nervous energy involved in a seeing task is achieved, and electrical energy usage for a given level of illumination is maximized.

The efficacy* of the LPS lamp varies from 131 to 183 lumens per watt (lpw), depending upon the wattage (see Table 1). Efficacies of other familiar light sources are compared in Table 2. (The 1000-watt size was chosen for these other sources because the efficacies of these lamps is highest at this wattage.)

The early LPS lamps had a low 50 lpw efficacy. Present values indicate that considerable progress has been made in design and constructio

A nanometer is a unit of wavelength equal to one-millionth of a millimeter

The efficacy of an electric lamp is the ratio of emitted luminous flux to power input, expressed in lumens per watt.

Table 1. Low-pressure-sodium lamp characteristics*

Lamp rating (watts)	Bulb length (in.)	Bulb diameter (in.)	Initial output (lumens)	Luminous efficacy (lpw)
35	12¼	2⅛	4,600	131
55	16¾	2⅛	7,700	140
90	20¾	2 11/16	12,750	142
135	30½	2 11/16	22,000	163
180	44	2 11/16	33,000	183

*Composite of presently available U-tube lamps with a life rating of 18,000 hours.

Table 2. Selected lamp type efficacies

Lamp type	Rating (watts)*	Output (lumens)	Efficacy (lpw)
Incandescent, PS-52	1,000	23,000	23
Mercury, clear, BT-56	1,000	57,000	57
Fluorescent, 1500 ma	215	16,000	74
Metal halide, BT-56	1,000	100,000	100
High-pressure sodium, T-18	1,000	140,000	140
Low-pressure sodium, T-21	180	33,000	183

*Wattages were chosen to show highest efficacies of each lamp type.

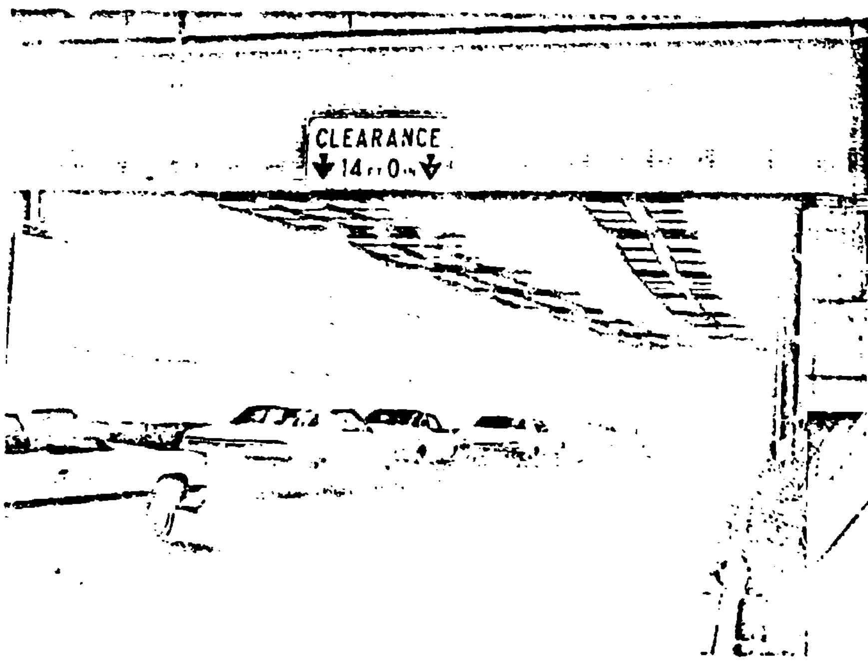
Further improvements can be expected with refined heat conservation procedures, and efficacies of 200 lpw and higher could soon be a reality.

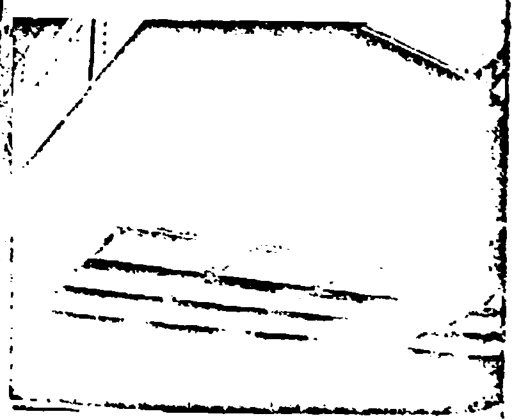
Construction

The accompanying drawing shows the construction of low-pressure-sodium lamps available in this country. (The LPS lamp is not manufactured in the United States; it is imported from Europe.) The lamp is characterized by a relatively long arc tube that is doubled back on itself to achieve convenient dimensions for a luminaire enclosure. (A linear, non-U-shaped lamp is also produced and used in Europe.)

The LPS lamp shown has a large-diameter arc tube and a two-pin, single-bayonet-type base at one end. In some types of lamps the sodium metal is distributed through the discharge tube using dimples or reservoirs spaced along the length of the tube. These reservoirs, which act as cold spots, keep the sodium in the proper location for a continuous discharge. Another type of lamp accomplishes the distribution of sodium by use of a tapered, invisible, heat-reflecting film deposit of indium oxide on the inside surface of the outer jacket which acts as a reflector to the infrared heat radiation emitted by the arc. This helps maintain the required 270C surface temperature of the arc tube by turning back the heat energy that otherwise would be dissipated by the lamp.

Sodium vapor is exceedingly reactive at high temperatures and chemically attacks most glasses, especially those which contain silica. Resulting





TUNNEL ILLUMINATION used to provide visual transition or adaptation from full daylight is typical application of low-pressure-sodium lamps. The criterion for this test installation in Philadelphia, Pa., was 1000 fc at the entrance, accomplished by using 51-by-26-in luminaires ceiling-mounted in five rows for 500 ft inside the tunnel. Temporary wall of plywood panels at left separates traffic lanes to insure accurate light measurements. Closeup (right) shows mirror-finished reflectors each carrying either two 180-watt lamps or one 180- and one 90-watt lamp. A glass lens seals the lamp enclosure.

Table 3. LPS lamp ballast characteristics*

Lamp rating (watts)	Input voltage (volts)	Input wattage (watts)	Starting voltage (volts)	Ballast weight (lbs)
35	240/120	60	390	7
	480	60	390	6
55	240/120	80	410	7
	480	80	410	6
	240/120	125	420	10
90	277	125	420	10
	480	125	420	10
135	240/120	178	575	16
135	277	178	575	16
	480	178	575	16
	240/120	220	600	16
180	277	220	600	16
	480	220	600	16

*Typical of presently available ballasts for single U-tube lamps, built-in for power-factor correction to 90% or above.

reduction of light output and actual disintegration of the arc tube caused a great deal of trouble in the past. However, special types of glass with silica largely replaced by boric oxide (to resist the sodium vapor) and laminated with lime-soda glass (to resist moisture) are now used to provide better stability of arc-tube materials.

Another early problem, the tendency of the glass to absorb argon during operation of the lamp, has been overcome with advancements in glass technology.

Ballasts

The LPS lamp, as other electric discharge lamps, requires the use of auxiliary electrical controls (ballasts) to supply necessary starting voltage and to limit operating current. This control of current is necessary because the electrical impedance of an arc discharge decreases with an increase of arc temperature, and the lamp could rapidly draw more current until it destroyed itself.

Electrically, LPS ballasts are similar to those used with mercury and metal-halide lamps and do not require the special high-voltage pulse required to start most of the high-pressure-sodium lamps. This simplifies the ballast design and improves the possibilities for trouble-free operation.

The minimum starting voltage ranges from 480 to 650 volts, depending on lamp size. Most ballasts used are the high-reactance transformer type, but lamps using reactor ballasts are satisfactory for a 480-volt supply circuit, since they receive the required voltage level in the starting pulse. The high-reactance ballast has better voltage regulation and a higher power factor than the reactor type, and in a case where a choice is available, it is generally preferred. Some lamp types using reactor ballasts increase their wattage requirements as they age, so that the electrical distribution system must be sized for the lamp's end-of-life requirements which can be 40 per cent higher than the initial lamp wattage rating.

Ballast total input wattage ranges from 60 to 220 watts, depending on lamp size. As lamp and ballast wattage increases, there is a significant improvement in ballast efficiency, with a greater percentage of the ballast input watts appearing as lamp watts. See Table 3.

Luminaires

Several manufacturers have complete lines of luminaires for outdoor application of LPS lamps, and other firms are developing models or contemplating entering the market. The luminaire housing used today is normally an aluminum, one-piece casting or an extrusion cut to length with end castings secured by continuous welding. Housings may have a baked enamel finish on the inside and outside surfaces. The lens is of glass or plastic (which is possible because of the relatively low operating temperature of the lamp), with either a flat or deep bowl configuration. Gasketing for the enclosure is ozone-resisting neoprene, pure wool (treated to resist moisture and heat) or an equivalent material.

The luminaire optical system, depending on the light distribution desired, may have a reflector and refractor combination or just a reflector with a clear, flat, enclosure cover. Units are available with either a cutoff, semicutoff or noncutoff light distribution, depending on optical system and lamp position within the housing. One luminaire, for example, has a lampholder mounting which is adjustable in three vertical positions for a choice of candlepower distributions.

Applications

The decidedly yellow color of the LPS lamp limits its application. However, based on extensive studies of its use for roadway lighting, light from the lamp gives the impression of greater brightness (for a given road surface luminance, for example) and provides greater visual acuity, greater speed of perception, and less discomfort glare than other popular roadway lighting systems.

At roadway intersections or pedestrian crossings, the lamp color can serve as a sign of caution to the motorist. In Europe, the LPS source is used for bypass roadways around large metropolitan areas, while mercury lamps light ramps and feeder roads. This provides an effective "color-coding" of such bypass roads, making their location and configuration readily discernible at a considerable distance.

Other applications where color discrimination is not an essential factor but where high efficacy, low wattage and other factors influencing system cost, installation, and maintenance can be of real and continued value include pedestrian crossings, bridges, railway crossings, tunnels and underpasses, shipyards, docks, industrial yards, quarries, mines, railroad yards, and large construction sites. Continuing concern for the optimization of electrical energy requires careful consideration to the possible use of the low-pressure-sodium lamp for applications such as these.

A Second Look At Low-Pressure Sodium

R. Stark and H. Cossyphas

An indirect roadblock to improved night visibility on expressways and at major intersections is the general assumption that advancements in this area would logically result in rising electrical energy costs. This impediment, and more practical demands for improved night visibility, prompted the State of Illinois Division of Highways to experiment with low-pressure sodium lighting along a one-mile stretch of heavily trafficked interstate highway. To the authors' best knowledge, this is the first major expressway installation of high-efficacy low-pressure sodium lamps in the United States.

Stevenson Expressway, a six-lane divided highway and a major Chicago artery, was undistinguishable with regard to lighting from other major interstates feeding metropolitan areas—until one year ago. At that time, an experimental one-mile long lighting installation of low-pressure sodium lamps became operable as the initial phase of a research program sponsored by the State of Illinois Division of Highways.

Stevenson Expressway, U. S. Interstate 55, was chosen as the site of the experiment since it lends itself easily to the evaluation of a lighting system under foggy or smoggy conditions. Prior to the experimental installation, mercury luminaires were used on the entire length of the road.

Because of cost considerations, the experiment was restricted to existing light standards and their locations. The 400-watt mercury luminaires simply were replaced with 180-watt tubular U-shaped low-pressure sodium units. The standards are set 14 feet back from the edge of the pavement, and are spaced at 150 feet. They are equipped with 12-foot mast arms which provide a 34-foot mounting height (Figure 1).

Both luminaires, mercury and low-pressure sodium, (Figure 2) met the IES categorization for medium vertical distribution, Type III lateral distribution, and semi-cutoff vertical control.

Performance data from the experiment were gathered to compare and evaluate the low-pressure sodi-

The Authors: Mr. Stark is a Registered Professional Engineer working as regional electrical engineer with the State of Illinois Dept. of Transportation, and a past chairman of the IES Roadway Lighting Committee. Mr Cossyphas is a Registered Professional Engineer working as special studies engineer with the State of Illinois Dept. of Transportation.

ATTACHMENT 10 #1

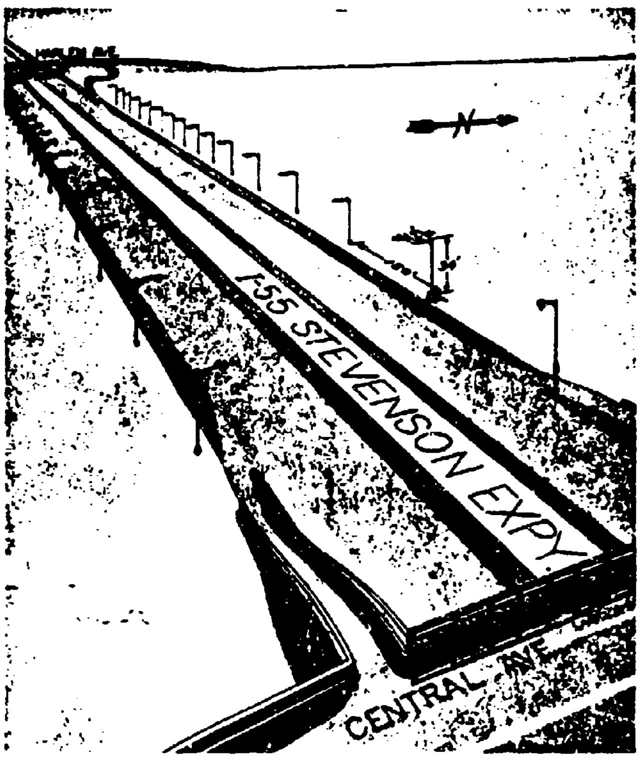


Figure I.

um and mercury installations in terms of:

Average Horizontal Illumination
Average Vertical Illumination
Uniformity of Illumination
Glare
Color Rendering
Sign and Delineation Visibility
Efficacy and Efficiency
Maintenance
Economics
Safety
Public Reaction and Preference

Photometric measurements from both sources were obtained by an illumination recorder. Instrumentation and operation of the recorder have been documented in previous studies.[1,2]

Horizontal illumination readings were taken with the sensing photocell mounted on the roof of a passenger vehicle, approximately five feet above the pavement. The sensing photocell was also mounted on the back side of the rear bumper, about one and one-half feet above the pavement, for vertical illumination readings. The test vehicle was driven at an approximate speed of 45 mph.

Portions of the strip chart outputs of the illumination recorder are illustrated in Figures 3 through 10, representing horizontal and vertical illumination levels for two eastbound lanes and two westbound lanes. These charts show readings for the same 1200-foot long expressway stretch. Results of the strip chart recorder outputs made possible the necessary calculations for average illumination, mean deviation, uniformity ratio, and uniformity of illumination.[3]

These results are represented in

Table I—Photometric Results

COMPONENT		Horizontal						Vertical					
DIRECTION		Eastbound			Westbound			Eastbound			Westbound		
LANE NO.		1	2	3	1	2	3	1	2	3	1	2	3
Mercury Vapor	$\bar{E}$.	.66	1.12	1.07	.69	1.1	1.07	0.58	0.65	0.60	0.56	0.61	0.58
	M.D.	0.248	0.485	0.446	0.21	0.474	0.445	0.175	0.218	0.215	0.174	0.214	0.212
	U.R.	1.7	2.38	2.85	1.68	2.40	2.81	1.45	1.62	2.	1.47	1.6	2.1
	U.I.	62.4	56.8	58.5	69.5	57.0	58.4	69.9	66.5	64.1	69.	65.	63.5
Low Pressure Sodium	$\bar{E}$.	1.02	1.58	2.32	1.04	1.61	2.34	0.75	0.95	1.06	.74	.93	1.02
	M.D.	0.175	0.617	1.137	0.171	0.645	1.198	0.098	0.225	0.315	0.092	0.222	0.313
	U.R.	1.22	1.7	2.5	1.2	1.7	2.5	1.87	1.9	1.77	1.89	2.05	1.8
	U.I.	82.6	62.3	51.1	83.6	59.9	48.9	87.	76.4	70.3	87.6	76.2	69.4

Table II—Glare-Contributions

	Mercury			Low-Pressure Sodium		
Lane	1	2	3	1	2	3
Disability (DVB in fl.)	.0397	.0854	.102	.0645	.117	.161
Discomfort (Avg. number)		7.112			7.058	

Table I for convenient comparison of the two systems. It should be noted, however, that mercury lighting measurements were taken after the luminaires had been operating for 9000 hours without any washing maintenance for nine months preceding the experiment. Under this condition, one would expect the light flux output of the luminaires to depreciate by at least 20 per cent. Increases in horizontal illumination levels were much more significant for lane No. 3 than for any of the other lanes. Increases in illumination levels for all lanes would have been more consistent if the low-pressure sodium luminaires were uptilted by approximately five degrees from the horizontal plane. This adjustment could not be provided, however, because of design characteristics of the luminaire model used in the experiment.

High light flux densities were observed on the shoulder and house side of the expressway, eliminating transverse transitional adaptation difficulties. This increase in the width of the motorists' field of view is believed to enhance a feeling of security by alleviating the fear of seclusion, usually suggested by lighting systems that do not illuminate areas adjacent to the roadway, or which over-emphasize optical guidance. Results of disability[4] and discomfort[5] glares calculated for both systems are shown in Table II.

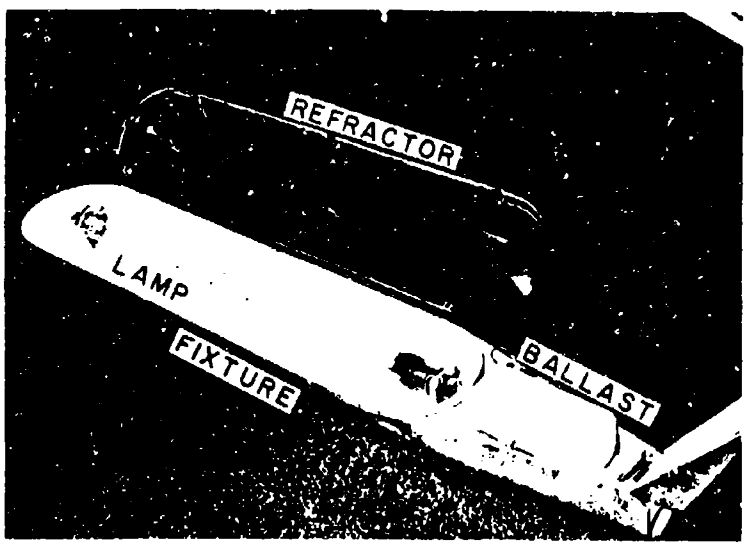


Figure 2. Low-pressure sodium luminaire.

Disability glare for the low-pressure sodium installation is considerably higher than that of the mercury system. (See Table II.) However, the resultant difference of loss in contrast between the two systems would not exceed five per cent in favor of the mercury system for any lane, even assuming equal illumination levels for both systems. It also is noted that the two systems offered numerically equivalent discomfort glare values. Of the two luminaires used in this experiment, the low-pressure sodium unit exhibits better discomfort glare control than mercury at comparable illumination levels.

A reduction in headlight glare from opposing traffic also was achieved by this installation. The increase in ambient illumination levels resulted in glare reduction from the headlights.

For multiple input information driving tasks, previous studies have shown that the effectiveness of highway signs depends on the target value technique employed.[6] A sign may fulfill the legibility criteria, but it remains ineffective unless it is actually read. It was observed that the yellow environment provided by the low-pressure sodium installation enhanced the noticeability of overhead directional signs lighted with fluorescent sources. The color contrast between the sign and the environment served as an attention gaining technique. The photometric characteristics of the illuminated signs were not otherwise

Motorists' Questionnaire

The State of Illinois, Department of Public Works and Buildings, is interested in your opinion concerning the low-pressure sodium lighting installation (yellowish lights), extending for one mile east of Harlem Avenue on the Stevenson Expressway.

Please answer only those questions which are clear to you; do not answer any questions on which you have no definite opinions.

1. How would you rank this lighting system in comparison to the lighting on the rest of the expressway, i.e., conventional lighting?

   Better—73% As Good—21% Worse—6%

2. Do you feel that this system provides more light on the road than the conventional system?

   Yes—81% No—5% Same as the Conventional —14%

3. Do you feel that this system offers more even light, i.e., less dark and bright spots on the pavement than the conventional lighting?

   Yes—89% No—5% Same as the Conventional —6%

4. Are the overhead signs more visible under this system than under conventional lighting?

   Yes—55% No—20% Same as the Conventional —25%

5. Are the signs located on the side of the road more visible under this system than under conventional lighting?

   Yes—54% No—20% Same as the Conventional —26%

6. Are the lane separating stripes more visible than under conventional lighting?

   Yes—66% No—16% Same as the Conventional —18%

7. Do these lights cause more glare than the other lights on the expressway?

   Yes—10% No—86% Same as the Conventional —4%

8. Is the true color of other vehicles on the road seen better under this system than under the conventional system?

   Yes—38% No—41% Same as the Conventional —21%

9. Can you see more of the ground adjacent to the road with this system than with the conventional system?

   Yes—78% No—8% Same as the Conventional —14%

10. Do you like this system?

    Yes—84% No—8% No Preference—8%

11. What do you like most about this system?

    Color—8% Amount of Light—26% Glare—9%
    Evenness of Light—30% General Visibility—27%

12. What do you dislike about this system?

    Color—55% Amount of Light—8% Glare—16%
    Evenness of Light—2% General Visibility—19%

13. If your answers above do not favor this lighting system, do you feel that your attitude might change by knowing that it costs less than conventional lighting?

    Yes—30% No—70%

14. Use this space for special comments, if any.

Please place this questionnaire in the attached self-addressed and post stamped envelope and mail it at your earliest convenience.

Your cooperation is highly appreciated by the division of highways.

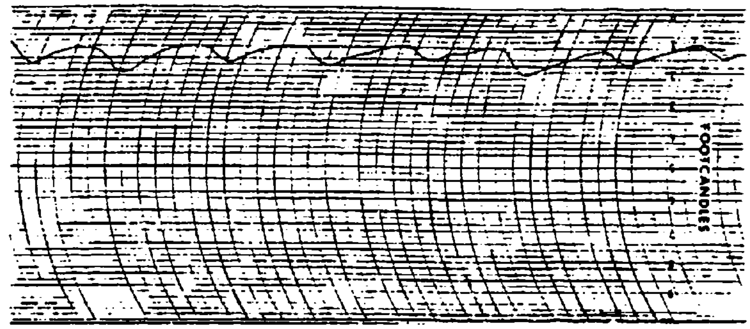


Figure 3. Eastbound lane No. 3, mercury installation.

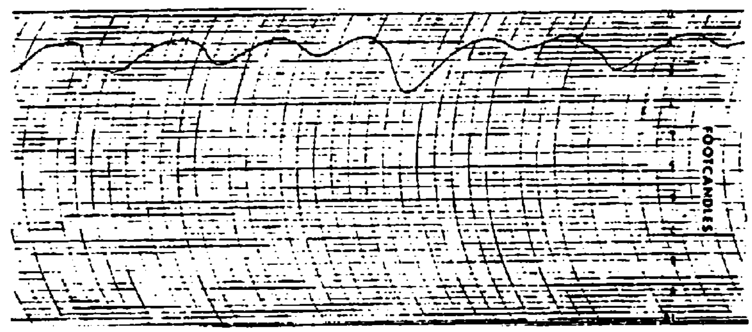


Figure 4. Eastbound lane No. 3, low-pressure sodium installation.

affected. The visibility of the unlighted roadway signs appeared to be somewhat improved by the low-pressure sodium light due to the increase of light flux in the house side of the road. The lane separating delineation stripes were enhanced under this system because of the improved color rendering of the pavement and stripes themselves.

In the area of true (daylight) color rendering, the low-pressure sodium installation appeared inferior to the mercury system, as anticipated. Low-pressure sodium emits monochromatic luminous flux at a wavelength of 585 nm. No other appreciable radiation is emitted in the visible spectrum. Consequently, all colors—except yellow—appear distorted.

The high efficacy of the low-pressure sodium lamp, 175 lumens per watt, results in considerable savings in power and materials. In this experimental installation, the illumination levels were increased while the power consumption was decreased to half of its previous level.

A dollar per footcandle economic analysis obviously favors low-pressure sodium systems due to lower power consumption, smaller wiring, and, possibly, larger spacings. Such a method, however, may not be entirely meaningful.

The low-pressure sodium units on Stevenson Expressway have been in operation for approximately one year. Consequently, no conclusions can be drawn regarding their maintenance. The manufacturer claims 50 per cent mortality* at 18,000 hours under normal operation cycles, and no light flux depreciation during the lamp life.

To determine the acceptance of the system by the general public, questionnaires were distributed to motorists of diverse driving backgrounds, including police officers, truck drivers, and lighting specialists. Results from the questionnaires were based on a population sample of 165.

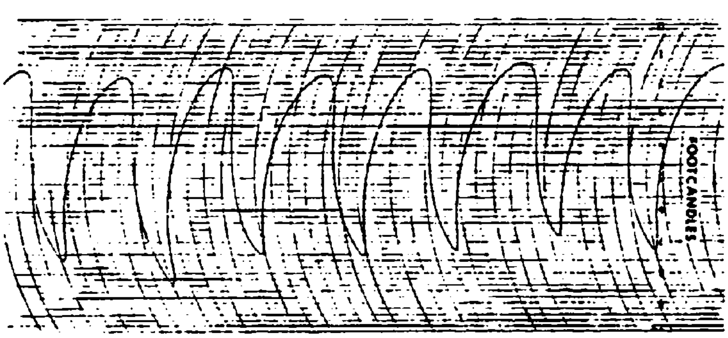


Figure 5. Westbound lane No. 1, mercury installation.

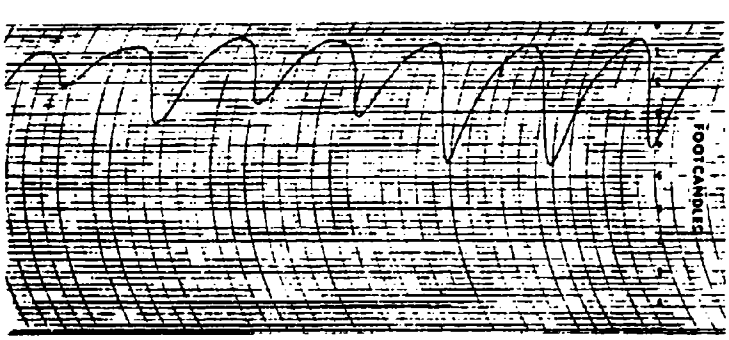


Figure 6. Westbound lane No. 1, low-pressure sodium installation.

*96 per cent survival at 10,000 hours under laboratory conditions.

10 - 5

Horizontal Illumination vs Distance (Approx. 27 ft/Division)

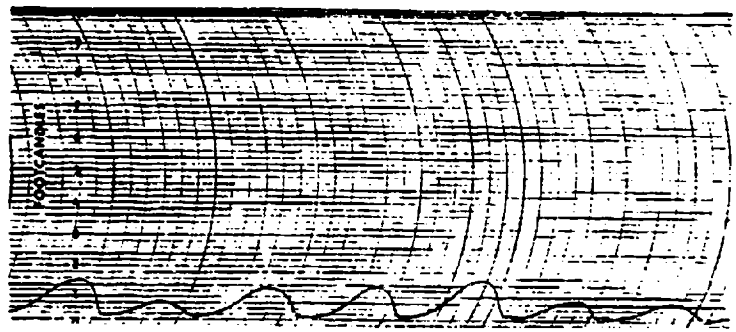


Figure 7. Eastbound lane No. 2, mercury installation.

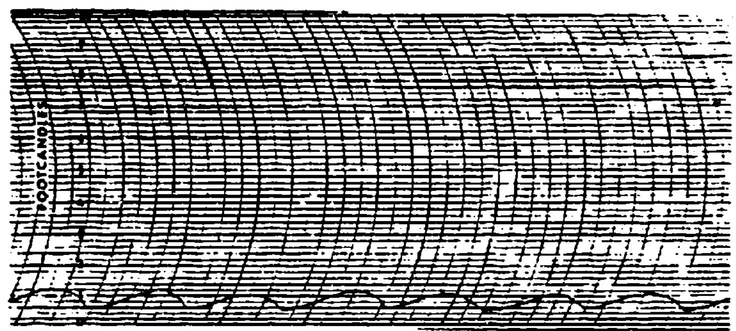


Figure 8. Eastbound lane No. 2, low-pressure sodium installation.

While the results of the sampling were not statistically analyzed with regard to the representativeness of the population and possible reactive influences affecting replies, it can be safely stated that the opinions received were decidedly favorable to low-pressure sodium over mercury, with the obvious exception of color rendering. Interestingly, of those individuals who generally did not favor the low-pressure sodium installation, some 70 per cent refused to be swayed in their convictions—even if the system would cost considerably less than conventional lighting.

Further experimentation with low-pressure sodium lighting by the Illinois Division of Highways is likely, so that the effects of these installations on accident rates may be studied and verified statistically.

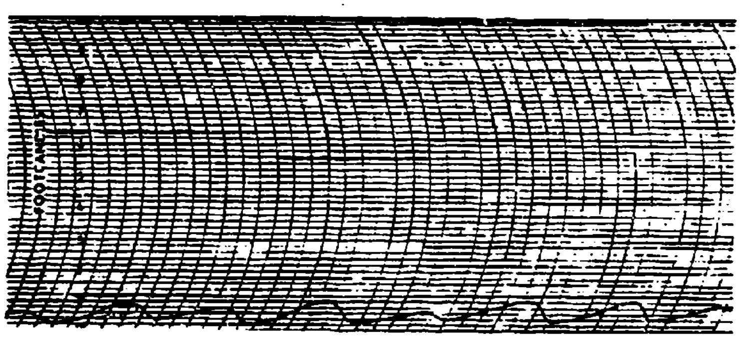
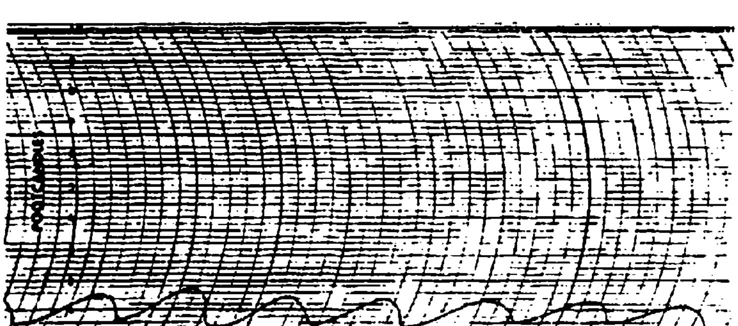


Figure 9. Westbound lane No. 3, mercury installation.



[illegible]

References

1. Cossyphas, H. and Stark, R., "Evaluation of an Experimental High Mount Illumination Technique For Expressway Interchanges," ILLUMINATING ENGINEERING, Vol. 66, February 1971, pp. 84-86.
2. State of Illinois, Department of Public Works and Buildings, Division of Highways, Electrical Bureau, Interim Report: Evaluation of High-Mount Area Lighting at the I-94 and I-80 Expressway Interchange, Chicago, Ill., April 1970.
3. LeVere, R. and Mahler, E., "Uniformity of Illumination," ILLUMINATING ENGINEERING, Vol. 65, April 1970, p. 211.
4. Fowle, A. W. and Kaercher, R. L., "Effective Control of Glare," ILLUMINATING ENGINEERING, May 1962, pp. 336-348.
5. deBoer, J. B. and Schreuder, D. A., "Glare as a Criterion for Quality in Street Lighting," *Transaction of the Illuminating Engineering Society* (London), Vol. 32, No. 2, 1967, pp. 117-135.
6. Forbes, T. W., Snyder, T. E., and Pain, R. F., "Traffic Sign Requirements," Highway Research Record, Number 70. Night Visibility 1963 and [illegible]

Energy conservation and luminaire dirt depreciation

A comparison of a mercury and a low-pressure sodium luminaire in terms of the effect of dust collection on luminous intensity

Perry Romano

In these days of energy conservation, it is important to reexamine the light loss factors that rob us of the full amount of light required for seeing tasks. One of the most important factors is luminaire dirt depreciation (LDD), the result of dust and dirt collecting on lamp and luminaire surfaces. This collection will progressively absorb the vital energy that is then lost as useful light on the work surfaces.

To combat this factor, it is necessary to determine how the lamp type, size, and the luminaire design affect the collection of dust and dirt and to what degree the luminaire is limited in its operation. This information will be valuable in luminaire design and application.

To gain new data on LDD, two different types of sources were tested in roadway luminaires. Each luminaire was given a complete photometric test when clean and was tested again after having been operated in a dust chamber. The tests were made independently at a nationally recognized test laboratory in accordance with IES recommended procedures. Tests were based on 60-plane photometry, with vertical increments of 2.5 degrees from 50 degrees to 90 degrees. Test distance exceeded 25 feet.

A 180-watt low-pressure sodium lamp (LPS) [1], rated 33,000 lumens, was tested in a roadway luminaire with a clear acrylic molded cover. A 400-watt, H400A33-1, clear mercury lamp (H), rated 19,667 lumens, was tested in a roadway luminaire (cobra-head) with an aluminum reflector and a glass refractor. Thermocouples were attached to the two luminaires in selected places, and one was suspended in the ambient air within each luminaire.

The accelerated tests in the dust chamber [2] cycled the luminaires in increments of two hours on and two hours off. It was found that the luminaires reached close to their maximum temperatures in two hours and cooled again to approximately ambient temperature in the next two-hour period. This cycling caused the luminaires to "breathe" as if

The author national sales manager, **Quality Outdoor Lighting**, Northbrook, Ill. **Dr. Ian Lewin** of Environmental Research Laboratories conducted the testing described in this article, and **William Welbel** served as a consultant. Both are contributing editors to *LD&A*

[1]

ATTACHMENT II-1

they had been in normal operation for a period of approximately 210 days.

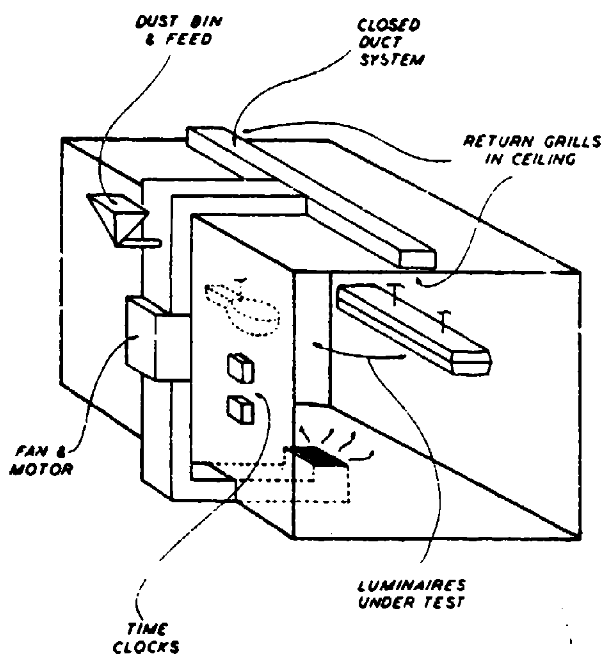
The dust chamber was an 8-foot by 8-foot by 8-foot room with a closed loop circulation ventilation system, with the one supply register located in the center of the floor. Dust was fed automatically into the return side of the fan, within the closed loop, and circulated. The dust used was the standard of air conditioning air filter manufacturers and consisted of a ratio of 90/10 of extremely fine desert silt and lampblack.

The photometric tests, after the accelerated dust collection, showed only a slight reduction in efficiency for the LPS luminaire, but there was a significant decrease for the H luminaire [**Table 1**].

The spacing of luminaires along a roadway and their mounting height are essential elements in system design. Such spacing and mounting are dependent on luminaire luminous-intensity distribution. The dust tests showed the extent to which luminaire luminous-intensity distribution was affected adversely by dust collection [**Table 2**]. Again, the data show the better performance of the LPS luminaire and emphasize the importance of LDD in luminaire and system design.

A reduction in candlepower is to be expected for both luminaires, because the dust collection on lamp and light control surfaces not only absorbs light, but acts as an added diffuser, scattering it in a less effective pattern. It is interesting, too, that the lateral plane of maximum candlepower was shifted 2.5 degrees by the collection of dust, changing the IES classification for the H luminaire from type III, medium, to type II, short. The classification of the LPS luminaire was unchanged from type III, short.

In the design of a lighting system, there is the question of the amount of light that will be delivered to the workplane, both initially and after



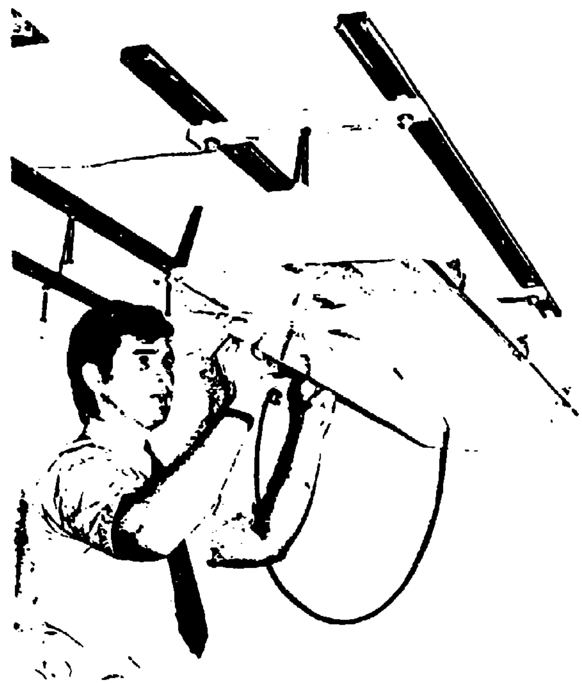
[2]

Table 1. Luminaire efficiency (per cent)

Luminaire	Clean	Dirty	Decrease
LPS	79.7	78.4	1.63
H	78.9	67.7	14.20

Table 2. Maximum luminous intensity in candelas

Luminaire	Clean	Dirty	Decrease (per cent)
LPS	9448	8550	9.50
H	9650	7850	18.65



[3]

Table 3. Coefficients of utilization—street side

Ratio*	LPS luminaire Clean	Dirty	Per cent decrease	H luminaire Clean	Dirty	Per cent decrease
0.5	0.169	0.167	1.2	0.170	0.146	14.1
1.0	0.274	0.271	1.1	0.377	0.309	18.0
1.5	0.329	0.325	1.2	0.477	0.391	18.0
2.0	0.358	0.353	1.4	0.523	0.431	17.6
2.5	0.374	0.369	1.3	0.549	0.453	17.5
3.0	0.384	0.378	1.6	0.563	0.465	17.4
3.5	0.391	0.385	1.5	0.573	0.474	17.3
4.0	0.394	0.389	1.3	0.578	0.478	17.3
5.0	0.398	0.393	1.3	0.585	0.485	17.1
Total	0.404	0.401	0.7	0.605	0.504	16.7

* Ratio: transverse width of street to luminaire mounting height.

depreciation. A useful factor in estimating the design quantity of light is the coefficient of utilization, the ratio of the lumens reaching the workplane to that of the total lumens leaving the lamp or lamps of the luminaire. Table 3 illustrates the affect of LDD on the coefficients of the two luminaires tested. It is apparent that the LPS luminaire was little affected by dust collection, but the H luminaire had considerable reduction in its ability to deliver quantities of light to the roadway.

The LPS luminaire has the additional advantage of a light source of much higher efficacy (lumens of light output per watt of lamp electrical input), higher total lumens, and lower wattage than the H luminaire. Lamp efficacy for the LPS is 183 lpw and for the H is 49.2 lpw, a ratio of 3.73 to 1. The higher efficacy of the LPS lamp and the lower LDD of its luminaire mean that much greater amounts of light can be delivered to the roadway from each LPS luminaire.

The higher operating temperature of the higher wattage H luminaire causes it to "breathe more deeply" and thus draw more dust into its optical system. Both luminaires were gasketed and the LPS luminaire had a larger volume of air enclosed in its optical system, but its much lower operating temperature enabled its gasketing to limit effectively the LDD. Also, the lower operating temperature of the LPS luminaire can be expected to act favorably on the life of luminaire components.

To summarize, the LPS luminaire outperformed the H luminaire in these tests and is the superior luminaire with regard to maintenance of luminous intensity, efficiency, and coefficients of utilization. These advantages, as well as the lower wattage and the higher light output and efficacy of the LPS lamp, are valuable in these continuing days of energy conservation. □

Exterior security fence lighting

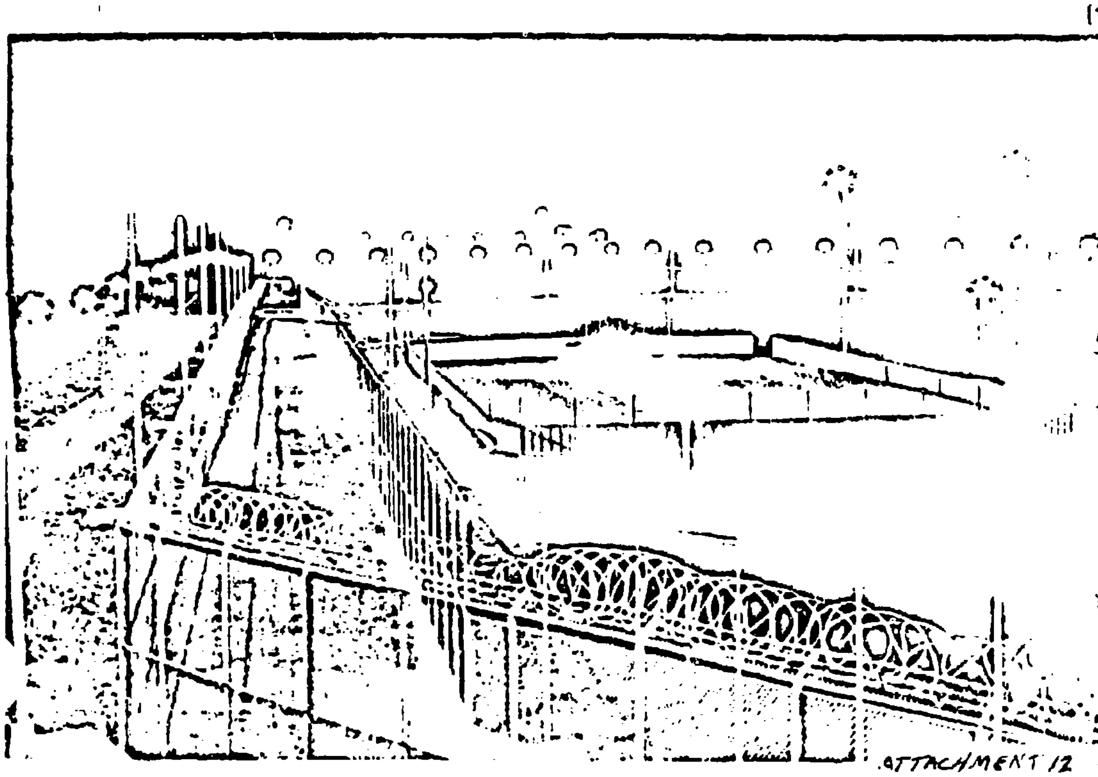
Low-pressure sodium sources for the exterior lighting of maximum security institutions have the advantages of high luminous efficacy, low arc-tube luminance, monochromatic light that offers a psychological and visual deterrent to inmates, and reliable starting characteristics

R. E. Jennings, P.E.

Social unrest at many penal institutions in both the United States and Canada over the past few years has resulted in tremendous interest in the application of new security and detection systems. It has also created a need for improvement in existing security lighting systems. This challenge can be met today because research and development in the field of illumination have provided new design criteria as well as new products.

The author head, Illumination Engineering, Dept. of Public Works, Ottawa, Canada

[1]



ATTACHMENT 12 2-1

high-intensity light sources and luminaires enable us to design lighting systems to improve the visual performance of the security staff.

This article analyzes and describes the effects of the more important factors that must be considered in designing an exterior security fence lighting system. We compare a previously installed system at a maximum security institution with a new system that has been designed with these several factors in mind.

Historically, early research concerned itself with the performance characteristics of human vision and established the fact that visual performance was not only dependent on the level of illumination of the visual task but also involved the four fundamental factors in vision: luminance, size, contrast and exposure duration. More recent research has shown that visual performance also depends on other physical properties of the luminous environment created by the lighting installation.

Level of illumination, vision factors, layout and the intensity of distribution of a light source, differences in task and background chromaticities, and psychological variables—all are interrelated and must be carefully considered in our effort to maximize visual performances in a normal environment.

A penal institution, however, cannot be considered a normal environment. Additional factors related to patterns of ocular search and scanning, as well as visual information processing, must be considered in designing exterior security fence lighting systems to assist in achieving maximum visual performance by the security staff under conditions of actual visual work.

The pattern of ocular search and scanning, as in the case of a security guard, may involve steadily fixating a suspicious area for several seconds or minutes or scanning a larger area. He may glance away from a suspicious point momentarily or he may institute an ocular scan of some other area. If the task surround has areas of luminance different from that of the task luminance, movements of the line of sight about the environment will produce losses in visual sensitivity due to transient adaptive effects.

Training, motivation, and fatigue are other factors that affect the visual performance of a security officer in the performance of his duties. It is not within the scope of this article to include a detailed description of all such factors, nor is it intended to detail methods and measurements required to establish such values. Studying and evaluating such factors as relative contrast sensitivity (RCS), contrast rendering factor (CRF), disability glare factor (DGF), and the transient adaptation factor (TAF) will ensure achieving maximum visual performance. The evaluation of the four aspects of illuminance environment as expressed by RCS, CRF, DGF, and TAF represents a considerable advancement over older methods that evaluated visual performance solely in terms of the quantity of illuminance.

Existing perimeter lighting

Double chain-link fences located 20 feet apart are usually installed around the perimeter of a maximum security institution. Strands of barbed wire are installed at the top of the 14-foot fence. During exercise periods, inmates are not permitted to approach to within 15 feet of the inner fence.

Exterior fence lighting systems installed in recently constructed institutions consist of 20-foot aluminum standards spaced 100 feet apart, and located approximately 5 feet outside an exterior fence on which is mounted a post-top incandescent luminaire rated at 370 watts, providing an IES Type 1 light distribution. This is a poor choice of luminaire, because it does not provide either the level of illumination or the quality of lighting required for this application. It also requires considerable maintenance.

The proposed lighting system, in addition to providing good uniformity and quality of lighting, offers adequate illuminance in four major areas:

- Between security fences.
- On the face of the inner security fence to a height of 5 feet from ground level.
- Fifteen-foot "no man's land" on compound side of inner fence.
- Leading away from the exterior fence.

The system should provide a maintained level of illuminance of 4.5 footcandles over the prescribed area, with a uniformity of no less than 1.25 to 1.0 over the area.

New lighting system

Our first concern in considering criteria for the design of this new exterior security fence lighting system was the selection of the light source. After a thorough investigation, we chose a low-pressure sodium lamp (LPS).

High luminous efficacy

The SOX 135-watt low-pressure sodium lamp chosen produces 159 lumens/watt, which is considerably higher than either clear mercury, metal halides, or high-pressure sodium light sources of the same rating. Its life rating of 15,000 hours compares favorably with other sources.

This meets our first design criterion: namely, to use minimum electrical input wattage to produce optimal illumination levels over a defined area. This was a very important consideration in our effort to conserve electrical energy. It was also an important consideration when the perimeter fence lighting system is supplied by standby power.

Lamp brightness

The arc tube luminance of the LPS lamp is 10 cd/cm^2—an extremely low value compared to values of 450 cd/cm^2 for clear high-intensity mercury lamps and 1000 cd/cm^2 for clear high-pressure sodium lamps.

This also met another design criterion: to avoid direct glare in the field of view of guards located in watchtowers, as well as those on foot patrol. It should permit scanning the area between fences with maximum visual capability.

Monochromatic yellow light

The output of a low-pressure sodium lamp is a virtually monochromatic yellow light (a doublet of 589 and 589.6 nm), which is very close to the eye's 555-nm peak sensitivity. Electrically, the benefits of the narrow bandwidth mean that energy is utilized where it will do the most good—in a narrow energy band to which the eye is extremely sensitive.

The monochromatic yellow light and the high level of illuminance prove most compatible when a television surveillance system is installed. It does not permit distinguishing colors or facial features, but it does offer good clarity and picture detail. And it results in increased visual acuity.

Historically, we have grown accustomed to interpret the color yellow as an indication of caution or danger: for example, yellow traffic lights and flashing roadway construction signs. I believe that it is quite possible that this yellow band of light around the perimeter of a maximum security satellite will prove to be a psychological as well as a visual deterrent to inmates contemplating escape.

Reliable starting

The ignition in an LPS lamp is by means of a gas discharge through a neon–argon gas mixture. Because there is nothing to vaporize to initiate the arc, these lamps are very reliable starters. The heat from the neon–argon discharge begins vaporizing the sodium, which increasingly contributes to the light output until, after about 12 to 15 minutes following start-up from cold start, the lamp's light is sodium yellow.

Most important, when normal power fails, the lamp provides instant restarting when the diesel generator comes on line, because the gas and sodium mixture is still hot.

Other advantages

- The lumen output of the LPS lamp remains unchanged throughout its life, which is rated 15,000 hours on 5-hour starts.
- Luminous output is within 5 per cent at −40°C.
- With reactor ballast, the lamp maintains luminous output within 6 per cent and lamp wattage within 8 per cent of nominal—with 20 per cent fluctuation in line voltage.

The luminaire selected for this application uses one 135-watt LPS lamp and produces a symmetrical twin-beam candlepower distribution for maximum reduction of contrast losses and discomfort glare. It has a maximum luminous intensity of 318.5 cd/100 lm, at an angle of 50° from nadir. The geometric configuration of the fence in relation to poles and mounting height of these luminaires is such that this beam of maximum intensity strikes the face of the inner fence 3 to 5 feet above ground level. This is the critical cutting zone for inmates attempting to escape.

The system chosen for lighting the exterior fence is an axially suspended catenary system. The design is based on the use of 30-foot octagonal steel poles with transformer type bases. Luminaires are mounted at 26 feet on 33-foot centers, with each span of the main suspension cable being terminated at each consecutive pole. Ballasts and fuses for three luminaires are located in these bases. Each span is individually wired.

To avoid increasing costs, we explored the possibility of using the existing underground duct and cable system. Because each 135-watt luminaire draws only 0.95 ampere and there are three luminaires per section for a total of 405 watts (as compared to the existing 370 watt luminaires), it was possible to employ the existing wiring system.

The existing concrete bases were not strong enough to accept the new steel poles; however, rather than replace these, we cut the tops off, diamond drilled new holes for the new anchor bolts, and installed a concrete "collar" to provide the required strength. This avoided breaking into the existing underground duct system and exposing it to moisture and other possible injury.

Field tests have proven that the new security fence lighting system has exceeded the design calculations and has provided a visual environment in accordance with all the factors previously stated. The system has been installed at three maximum security institutions to date and the security staff has reported a definite improvement in visual performance, particularly during periods of intense fog. Uniformity is excellent and has permitted removal of the coils of barbed wire placed at ground level between the fences. □

2-21-78
Lighting Study Comp in Prog

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HDR SYSTEMS INC.  COMPUTING SERVICES.  JOB NAME = ACZOCTT
 NOS 1.2-452        OPERATING SYSTEM        USER = BCE0105
           JOB ORIGIN = EI200.
          JOBCARD NAME = JOB

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 AAAAAAAAA   CCCCCCCCC   ZZZZZZZZZ  000000000   CCCCCCCCC   TTTTTTTTT   TTTTTTTTT
 A       A   C       C          Z   0       0   C       C       T           T
 A       A   C                 Z    0       0   C               T           T
 A       A   C                Z     0       0   C               T           T
 AAAAAAAAA   C           ZZZZZZZZZ  0       0   C               T           T
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 A       A   C              Z       0       0   C               T           T
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ATTACHMENT 13

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C
C-OMAHA DISTRICT, U.S. ARMY CORPS OF ENGINEERS
C-DATE SPETEMBER 1975
C
C-AUTHOR M.E. FLETCHER
C
C-DEFINITIONS OF ARRAYS AND ELEMENTS
C
C   ARRAY CPH(90)
C     PURPOSE-HOLDS THE VALUES OF HORIZONTAL ANGLES FOR THE CANDLEPOWER
C       TABLE.
C
C   ARRAY CPV(40)
C     PURPOSE-HOLDS THE VALUES OF VERTICAL ANGLES FOR THE CANDLEPOWER
C       TABLE.
C
C   ARRAY CP(90,40)
C     PURPOSE-HOLDS THE CANDLEPOWER ARRAY IN MEMORY FOR THE CURRENT
C       LUMINAIRE.
C     1ST SUBSCRIPT
C       1-60 VALUES IN THE HORIZONTAL DIRECTION
C     2ND SUBSCRIPT
C       1-60 VALUES IN THE VERTICAL DIRECTION
C
C   ARRAY-POST(150,6)
C     PURPOSE-A LIST OF THE INDIVIDUAL LUMINAIRES, THEIR POSITIONS AND
C       AND AIMING, TO BE CONSIDERED IN THE CALCULATIONS.
C     1ST SUBSCRIPT
C       1-150 DIFFERENT LUMINAIRE POSITIONS
C     2ND SUBSCRIPT
C       1 THE SUBSCRIPT OF THE ENTRY IN THE ANDEXI ARRAY FOR THE
C         LUMINAIRE WITH THE SAME LUMID
C       2 THE X-COORDINATE OF THE LUMINAIRE>S POSITION
C       3 THE Y-COORDINATE OF THE LUMINAIRE>S POSITION
C       4 THE Z-COORDINATE OF THE LUMINAIRE>S POSITION
C       5 THE HORIZONTAL ANGLE OF THE LUMINAIRE>S AIM.  HORIZONTAL
C         ANGLES ARE MEASURED COUNTERCLOCKWISE FROM THE POSITIVE
C         X-AXIS
C       6 THE VERTICAL ANGLE OF THE LUMINAIRE>S AIM
C
C   ARRAY-TGRID(30,30,4)
C     PURPOSE-HOLDS THE COORDINATES AND FOOTCANDLES OF POINTS ON THE
C       TEST GRID FOR WHICH ILLUMINATION IS COMPUTED.
C     1ST SUBSCRIPT
C       1-30 X-COORDINATES TO BE PRINTED ACROSS THE TOP OF THE PAGE
C     2ND SUBSCRIPT
C       1-30 Y-COORDINATES TO BE PRINTED DOWN THE PAGE
C     3RD SUBSCRIPT
C       1 X-COORDINATE OF THE POINT
C       2 Y-COORDINATE OF THE POINT
C       3 Z-COORDINATE OF THE POINT
C       4 THE ILLUMINATION AT THE POINT
C
C   ARRAY-IPID(15)
C     PURPOSE-HOLDS A 60 CHARACTER PROJECT    ITIFICATION WHICH IS
C       PRINTED AT THE TOP OF EACH PAGE OF OUTPUT
```

```
C
C-ARRAYS AND CONSTANT DATA
      PROGRAM PTPLT(INPUT,OUTPUT,TAPE1,TAPE98=INPUT)
      COMMON /T2V/ CPH(40),CPV(40),CP(40,40),HV,FID,NH,NV
      COMMON /T2V/ CM(6,4)
      COMMON /GND/ POST(150,6)
      COMMON /GRD/ TGRID(30,30,4),NUMX,NUMYZ
      COMMON /PID/ IPID(15),IPAGE,LINLIM,LINE
      COMMON /CON/ PI,DEGRAD,RADDEG,PID2
      COMMON /DIR/ UID(10),DLAMPT(10),DDIPTT(10),OTHECT(10)
      COMMON /XYZ/ COSXX,COSXY,COSXZ,COSYX,COSYY,COSYZ,COSZX,COSZY,COSZZ
      COMMON /DEV/ IDEV1,IDEV2,IDEV3,IDEV4,IDEV5,IDEV6
      COMMON /ISW/ ISW1,ISW2,ISW3,ISW4,ISW5,ISW6
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      DATA PI/3.1415926535897/
      DATA F9/99999999./
     A A9/10H9999999999/, SPACES/10H          /
     A IYES/1/,INO/0/
      DATA IPAGE,LINLIM/0,55/
      DEGRAD = PI/180.
      RADDEG = 180./PI
      PID2 = PI/2.
      PIX2 = 2.*PI
      PIX3 = 3.*PI
      PIX1P5 = 1.5*PI
      PIX2P5 = 2.5*PI
      IM = 0
      IDEV1 = 1
      IDEV2 = 98
C-READ PROGRAM CONTROLS
  100 READ(IDEV2,110) ITYPE,ISW1,ISW2,ISW3,ISW4,ISW5,ISW6
  110 FORMAT(A5,5X,6I10)
      IF(EOF(IDEV2)) 900,115
  115 CONTINUE
C-READ PROJECT IDENTIFICATION
  200 READ(IDEV2,210) ITYPE,IPID
  210 FORMAT(A5,5X,15A4)
       IF(EOF(IDEV2)) 900,215
C-PRINT PROGRAM CONTROLS
  215 CALL PAGE
      PRINT 220, ISW1,ISW2,ISW3,ISW4,ISW5,ISW6
  220 FORMAT(10X,"ISW1 =",I3,"  1=PRINT CANDLEPOWER TABLES           "/
     2          10X,"ISW2 =",I3,"  1=DISK DIRECTORY PRINT              "/
     3          10X,"ISW3 =",I3,"  1=PRINT EACH POINT AFTER CALCULATION"/
     4          10X,"ISW4 =",I3,"  1=PRINT + ZERO GRID AFTER EACH LIGHT"/
     5          10X,"ISW5 =",I3,"  1=PRINT ALL CANDLEPOWER TABLES       "/
     6          10X,"ISW6 =",I3,"  1=USE TS PAGE CHANGES               "/)
      PRINT 230,IDEV1,IDEV2,IDEV3,IDEV4,IDEV5,IDEV6
  230 FORMAT(10X,"IDEV1 =",I3,"  CANDLEPOWER TABLES                    "/
     2          10X,"IDEV2 =",I3,"  DESIGN INPUT                          "/
     3          10X,"IDEV3 =",I3,"                                        "/
     4          10X,"IDEV4 =",I3,"                                        "/
     5          10X,"IDEV5 =",I3,"                                        "/
     6          10X,"IDEV6 =",I3,"                                        "/)
C-SECTION TO INITIALIZE CANDLEPOWER FILES
      CALL OPENMS(IDEV1,INDEX1,800,0)
      CALL READMS(IDEV1,ANDEX1,200,1)
```

```
      NUMLUM = ANDEX1(200)
C-SECTION TO PRINT DISK DIRECTORY
      IF(ISW2 .GT. 0) CALL DRPRNT
C-SECTION TO PRINT ALL CANDLEPOWER TABLES
      IF(ISW5 .LT. 1) GO TO 250
      DO 240 IA = 1,NUMLUM
  240 CALL CPPRNT(IA)
      GO TO 900
  250 CONTINUE
C-DEPRECIATION FACTORS
  300 DO 310 I = 1,10
      UID(I) = SPACES
      DLAMPT(I) = 1.
      DDIRTT(I) = 1.
      OTHFCT(I) = 1.
  310 CONTINUE
      NUMUSE = 0
      PRINT 320
  320 FORMAT(1H )
      PRINT 330
  330 FORMAT(10X,"INPUT DATA - DEPRECIATION FACTORS")
      PRINT 320
      PRINT 340
  340 FORMAT(10X,"LUMID        DLAMP        DDIRT        OTHFC")
      PRINT 350
  350 FORMAT(10X,4("----------  "))
  360 READ(IDFV2,370) ITYPE,AID,DLAMP,DDIRT,OTHFC
  370 FORMAT(A5,5X,A10,3F10.0)
      IF(AID .EQ. A9) GO TO 500
C----TEST FOR NOT CURRENTLY IN DEPRECIATION FACTOR TABLE
      DO 380 IA = 1,NUMUSE
      IF(AID .EQ. UID(IA)) GO TO 390
  380 CONTINUE
      GO TO 410
  390 PRINT 400, AID
  400 FORMAT(10X,"ERROR-    ",A10," DEPRECIATION FACTORS PREVIOUSLY",
     2     ," GIVEN")
      GO TO 360
C----TEST FOR LUMINAIRE IN MASTER FILE
  410 DO 420 IA = 1,NUMLUM
      IF(AID .EQ. ANDEX1(IA)) GO TO 440
  420 CONTINUE
      IERR1 = IYES
      PRINT 430, AID
  430 FORMAT(10X,"ERROR-    ",A10," NOT IN CANDLEPOWER FILE")
      GO TO 360
C----SECTION TO MAKE ENTRY IN DIRECTORY
  440 NUMUSE = NUMUSE + 1
      UID(NUMUSE) = AID
      DLAMPT(NUMUSE) = DLAMP
      DDIRTT(NUMUSE) = DDIRT
      OTHFCT(NUMUSE) = OTHFC
      PRINT 450, AID,DLAMP,DDIRT,OTHFC
  450 FORMAT(10X,A10,3F12.4)
      GO TO 360
C-READ LUMINAIRE POSITION AND ORIENTATION
  500 NUNIT = 0
```

3-7

```
      IERR2 = INO
  510 READ(IDEV2,520) ITYPE,AID,X,Y,Z,H,V
  520 FORMAT(A5,5X,A10,5F10.0)
      IF(EOF(IDEV2)) 900,525
  525 IF(AID .EQ. AS) GO TO 560
C-SEARCH DIRECTORY OF LUMINAIRE TYPES FOR A MATCH
      DO 530 IA = 1,NUMLUM
      IF(AID .EQ. ANDEX1(IA)) GO TO 540
  530 CONTINUE
      PRINT 532, AID
  532 FORMAT(10X,"ERROR-    ",A10,"NOT IN CANDLEPOWER FILE")
      IERR2 = IYES
  540 DO 542 IB = 1,NUMUSE
      IF(AID .EQ. UID(IB)) GO TO 550
  542 CONTINUE
      IERR2 = IYES
      PRINT 544, AID
  544 FORMAT(10X,"ERROR-    ",A10," NO DEPRECIATION FACTORS ENTERED")
      GO TO 510
C-STORE DATA IN ARRAY POST WITH ANGLES CONVERTED TO RADIANS
  550 F = IA
      NUNIT = NUNIT + 1
      POST(NUNIT,1) = F
      POST(NUNIT,2) = X
      POST(NUNIT,3) = Y
      POST(NUNIT,4) = Z
      POST(NUNIT,5) = H * DEGRAD
      POST(NUNIT,6) = V * DEGRAD
      CALL PSPRNT(NUNIT)
      GO TO 510
  560 IF((IERR1 .EQ. IYES) .OR. (IERR2 .EQ. IYES)) GO TO 900
C-PRINT CANDLEPOWER TABLES OF THE LUMINAIRES USED
      IF(ISW1 .LT. 1) GO TO 600
      DO 570 IA = 1,NUMUSE
      DO 570 IB = 1,NUMLUM
      IF(UID(IA) .EQ. ANDEX1(IB)) CALL CPPRNT(IB)
  570 CONTINUE
      ISW1 = 0
C-READ DATA FOR TEST GRID
  600 IGRID = 0
  610 READ(IDEV2,620) ITYPE,XGRID1,YGRID1,ZGRID1,XGRID2,YGRID2,ZGRID2
  620 FORMAT(A4,6X,6F10.0)
      IF(XGRID1 .GT. F9) GO TO 500
      IGRID = IGRID + 1
      CALL PAGE
      PRINT 630, IGRID,XGRID1,YGRID1,ZGRID1,XGRID2,YGRID2,ZGRID2
  630 FORMAT(10X,"TEST GRID POSITION AND SIZE - TEST GRID", I3//
     1    10X,"XGRID1     YGRID1     ZGRID1     XGRID2     YGRID2     ",
     2    "ZGRID2"/10X,6("-------    ")/7X,6F10.2)
      READ(IDEV2,640) ITYPE,NUMX,NUMYZ,ICOMP,HMETER,
     1    XGRID3,YGRID3,ZGRID3
  640 FORMAT(A4,6X,2I10,9X,A1,4F10.0)
      IF(NUMX .GT. 30) NUMX = 30
      IF(NUMYZ .GT. 30) NUMYZ = 30
      PRINT 650, NUMX,NUMYZ,ICOMP,HMETER,XGRID3,YGRID3,ZGRID3
  650 FORMAT(//10X,"NUMX       NUMYZ      ICOMP      HMETER     XGRID3     ",
     1    "YGRID3     ZGRID3"/, 10X, 7("-------    ")/
```

```
      2    7X,2I10,9X,F1.4F10.2)
      HMETER = HMETER * DEGRAD
      DO 660 I = 1,30
      DO 660 J = 1,30
      DO 660 K = 1,4
  660 TGRID(I,J,K) = 0.
C-CALCULATE THE COORDINATES OF THE TEST GRID POINTS
      IF((XGRID3 .NE. 0.) .OR. (YGRID3 .NE. 0.) .OR. (ZGRID3
     1    .NE. 0.)) GO TO 670
      XGRID3 = XGRID2
      YGRID3 = YGRID1
      ZGRID3 = ZGRID1
  670 CONTINUE
      XGRID4 = XGRID1 + XGRID2 - XGRID3
      YGRID4 = YGRID1 + YGRID2 - YGRID3
      ZGRID4 = ZGRID1 + ZGRID2 - ZGRID3
      I = 1
      C2 = NUMYZ
      DO 680 J = 1,NUMYZ
      C1 = J - 1
      C2 = C2 - 1.
      C3 = C1 + C2
      TGRID(I,J,1) = (C2*XGRID1 + C1*XGRID4)/C3
      TGRID(I,J,2) = (C2*YGRID1 + C1*YGRID4)/C3
      TGRID(I,J,3) = (C2*ZGRID1 + C1*ZGRID4)/C3
  680 CONTINUE
      C2 = NUMX - 2
      C3 = C2 + 1.
      DX = (C2*XGRID1 + XGRID3)/C3 - XGRID1
      DY = (C2*YGRID1 + YGRID3)/C3 - YGRID1
      DZ = (C2*ZGRID1 + ZGRID3)/C3 - ZGRID1
      DO 690 I = 2,NUMX
      DO 690 J = 1,NUMYZ
      TGRID(I,J,1) = TGRID(I-1,J,1) + DX
      TGRID(I,J,2) = TGRID(I-1,J,2) + DY
      TGRID(I,J,3) = TGRID(I-1,J,3) + DZ
  690 CONTINUE
C-CALCULATE ILLUMINATION AT POINTS ON THE TEST GRID
  700 DO 770 LIGHT = 1, NUNIT
      NHEAD = 1
      IL = POST(LIGHT,1)
      XL = POST(LIGHT,2)
      YL = POST(LIGHT,3)
      ZL = POST(LIGHT,4)
      HL = POST(LIGHT,5)
      VL = POST(LIGHT,6)
      DO 710 IA = 1,NUMUSE
      IF(UID(IA) .EQ. ANDEXI(IL)) GO TO 712
  710 CONTINUE
      PRINT 544, ANDEXI(IL)
      GO TO 900
  712 DLAMP = DLAMPT(IA)
      DDIRT = DDIRTT(IA)
      OTHFC = OTHFCT(IA)
      IF(IL  .EQ. IM ) GO TO 720
      CALL RANIN(IL)
      POLAR = HV
```

13-6

```
  720 IN  = IL
      HLD = HL*RADDEG
      VLD = VL*RADDEG
      IF(ISW3.GT.0) CALL PAGE
      IF(ISW3.GT.0) PRINT 725, LIGHT,XL,YL,ZL,HLD,VLD,IL
  725 FORMAT(10X, "LIGHT", I3, 3X, " (", 3F8.2, ")", 2F8.2, I8)
      LINE = LINE + 1
      NHEAD = 1
C-ADJUST VERTICAL AIMING ANGLE
      IF(POLAR .EQ. IHV) GO TO 730
C-----FOR A FLOODLIGHT (HORIZONTAL POLAR AXIS)
      VLC = PI - VL
      GO TO 734
C-----FOR A ROADWAY LUMINAIRE (VERTICAL POLAR AXIS)
  730 IF(VL .GT. PID2) GO TO 732
      VLC = PID2 - VL
      GO TO 734
  732 VLC = PIX2P5 - VL
  734 CONTINUE
C-POINT CALCULATION LOOPS
      DO 760 IX = 1,NUMX
      DO 760 IYZ = 1,NUMYZ
      XG = TGRID(IX,IYZ,1)
      YG = TGRID(IX,IYZ,2)
      ZG = TGRID(IX,IYZ,3)
      X = XG - XL
      Y = YG - YL
      Z = ZG - ZL
C-COMPUTE DISTANCES AND ANGLES TO POINT IN MAIN COORDINATE SYSTEM
      R = SQRT(X*X + Y*Y + Z*Z)
      RH = SQRT(X*X + Y*Y)
      HXY = ATANSP(X,Y)
      COSZP = Z/R
      IF(R .NE. 0.) GO TO 735
         FC = 9999999999.
         GO TO 750
  735    CONTINUE
C-SELECT CALCULATIONS DEPENDING ON POLAR AXIS
      IF(POLAR .EQ. IHV) GO TO 736
C-----FOR A FLOODLIGHT LUMINAIRE
      CALL COSFLD(HL,VLC)
      XC = COSXX*X + COSXY*Y + COSXZ*Z
      YC = COSYX*X + COSYY*Y + COSYZ*Z
      ZC = COSZX*X + COSZY*Y + COSZZ*Z
      VC = ACOS(ZC/R)
      COSH = 1.
      SINVC = SIN(VC)
      IF(SINVC .NE. 0.) COSH = XC/(R*SINVC)
      IF(COSH .GT. 1.) COSH = 1.
      IF(COSH .LT. -1.) COSH = -1.
      HC = ACOS(COSH)
      IF(YC .LT. 0.) HC = PIX2 - HC
      H = PI - VC
      IF((XC .LE. 0.) .AND. (ZC .GT. 0.)) H = PI + VC
      IF((XC .LT. 0.) .AND. (ZC .LE. 0.)) H = PI + VC
      V = -HC
      IF(YC .LT. 0.) V = PIX2 - HC
```

```
      V = -V
      GO TO 738
C-----FOR A ROADWAY LUMINAIRE
  736 CALL COSROD(HL,VLC)
      XC = COSXX*X + COSXY*Y + COSXZ*Z
      YC = COSYX*X + COSYY*Y + COSYZ*Z
      ZC = COSZX*X + COSZY*Y + COSZZ*Z
      VC = ACOS(ZC/R)
      COSH = 1.
      SINVC = SIN(VC)
      IF(SINVC .NE. 0.) COSH = XC/(R*SINVC)
      IF(COSH .GT. 1.) COSH = 1.
      IF(COSH .LT. -1.) COSH = -1.
      HC = ACOS(COSH)
C     HCP = HC * RADDEG
C     VCP = VC * RADDEG
C     IF(ISW3 .GT. 0.) PRINT 780, XC,YC,ZC,HCP,VCP
C 780 FORMAT(10X, 5F10.2)
      IF(YC .LT. 0.) HC = PIX2 - HC
      H = HC + PID2
      IF(H .GT. PIX2) H = H - PIX2
      V = VC - PID2
  738 CONTINUE
C-PERFORM CANDLEPOWER TABLE LOOK UP
      CALL INT2V(H,V,CPL)
      HTABLE = H * RADDEG
      VTABLE = V * RADDEG
      FC = CPL * DLAMP * DDIRT * OTHFC/(R * R)
C-SELECT HORIZONTAL OR VERTICAL FOOTCANDLES
      IF(ICOMP .EQ. IHV) GO TO 748
      IF(ICOMP .EQ. IHU) GO TO 750
C-COMPUTE HORIZONTAL FOOTCANDLES (LIGHT METER VERTICAL UPWARD)
      FC = FC * ABS(COSZP)
      GO TO 750
C-COMPUTE VERTICAL FOOTCANDLES (LIGHT METER HORIZONTAL AT ANGLE HMETER)
  748 FC = FC * RH/R
      HXY180 = HXY + PI
      IF(HXY180 .GT. PIX2) HXY180 = HXY180 - PIX2
      HV = HXY180 - HMETER
      COSHV = COS(HV)
      FC = FC * COSHV
      IF(COSHV .LT. 0.) FC = 0.
C-ACCUMULATE FOOTCANDLES
  750 TGRID(IX,IYZ,4) = TGRID(IX,IYZ,4) + FC
      HXY = HXY * RADDEG
      IF(ISW3.GT.0) CALL PTPRNT(IX,IYZ,XG,YG,ZG,HXY,HTABLE,VTABLE,CPL,R,
     1 RH,FC,NHEAD)
  760 CONTINUE
      IF(ISW4.EQ.0) GO TO 770
      CALL GRPRNT(IGRID,XGRID1,YGRID1,ZGRID1,
     1     XGRID2,YGRID2,ZGRID2,XGRID3,YGRID3,ZGRID3,
     2     XGRID4,YGRID4,ZGRID4)
      DO 768 J = 1,30
      DO 768 I = 1,30
  768 TGRID(I,J,4) = 0.
  770 CONTINUE
C-PRINT RESULTS
```

```
      CALL AVOUNT
      CALL GRPHNT(IGRID,XGRID1,YGRID1,ZGRID1,XGRID2,YGRID2,ZGRID2,
     1   XGRID3,YGRID3,ZGRID3,XGRID4,YGRID4,ZGRID4)
C-GO BACK FOR NEXT GRID
      GO TO 610
  900 CONTINUE
      CALL CLOSMS(IDEV1)
      REWIND IDEV2
      CALL DATE(PDATE)
      CALL TIME(PTIME)
      PRINT 910, PDATE, PTIME
  910 FORMAT(//10X,"END OF RUN    ",2(A9,1X))
      STOP
      END
```

```
C-SUBROUTINE FOR PRINTING LUMINAIRE POSITION AND AIMING
      SUBROUTINE PSPRNT(NUNIT)
      COMMON /END/ POST(150,6)
      COMMON /PID/ IPID(15),IPAGE,LINLIM,LINE
      COMMON /CON/ PI,DEGRAD,RADDEG,PI02
      COMMON /PIP/ UID(10),DLAMPT(10),DDIRTT(10),OTHFCT(10)
      DATA IFIRST/0/
      IF(IFIRST .EQ. 0) GO TO 110
      IF(LINE.LT.LINLIM) GO TO 200
  110 CALL PAGE
      IFIRST = 7999999
      PRINT 130
  130 FORMAT(10X,"LUMINAIRE POSITION AND AIMING DATA")
      PRINT 140
  140 FORMAT(10X,"UNIT    LUMINAIRE",43X,"HORZ          VERT")
      PRINT 150
  150 FORMAT(10X,"NO       IDCODE         X-COORD        Y-COORD        Z-COORD
     1     ANGLE          ANGLE")
      PRINT 160
  160 FORMAT(10X, "----", 6("   ----------"))
      LINE = LINE + 6
C-PRINT ONE LINE CORRESPONDING TO UNIT
  200 H = POST(NUNIT,5) * RADDEG
      V = POST(NUNIT,6) * RADDEG
      ITYPE = POST(NUNIT,1)
      PRINT 210,NUNIT,UID(ITYPE),(POST(NUNIT,J),J=2,4),H,V
  210 FORMAT(10X,I4,3X,A10,5F13.2)
      LINE = LINE + 1
      RETURN
      END
```

```
      C-THIS SUBROUTINE PRINTS THE TEST GRID OF FOOTCANDLE VALUES
            SUBROUTINE GRPRNT(IGRID,XGRID1,YGRID1,ZGRID1,XGRID2,YGRID2,ZGRID2,
           1    XGRID3,YGRID3,ZGRID3,XGRID4,YGRID4,ZGRID4)
            COMMON /GRD/ TGRID(30,30,4),NUMX,NUMYZ
            COMMON /PID/ IPID(15),IPAGE,LINLIM,LINE
      C-INITIALIZE
            IX1 = -9
            IX2 = 0
      C-MAIN LOOP
        100 IX1 = IX1 + 10
            IX2 = IX2 + 10
            LINE = 999999
            IF((IX1 .GT. NUMX) .AND. (IYZ .GE. NUMYZ)) GO TO 300
            IYZ = 0
        110 IYZ = IYZ + 1
            IF(IYZ .GT. NUMYZ) GO TO 100
            IF(IX2.LE.NUMX) GO TO 115
            NX1 = NUMX + 1
            DO 114 IX = NX1,IX2
            TGRID(IX,IYZ,4) = 0.
            TGRID(IX,IYZ,1) = 0.
        114 CONTINUE
        115 CONTINUE
            IF(LINE .LE. LINLIM) GO TO 200
      C-CHANGE PAGE AND PRINT HEADING
            CALL PAGE
            PRINT 120
        120 FORMAT(1H )
            PRINT 130, IGRID,XGRID1,YGRID1,ZGRID1
        130 FORMAT(10X,"TEST GRID",I3,3X,"COORDINATES OF CORNER 1",3F13.2)
            PRINT 140, XGRID2,YGRID2,ZGRID2,XGRID3,YGRID3,ZGRID3,
           1    XGRID4,YGRID4,ZGRID4
        140 FORMAT(25X, "COORDINATES OF CORNER 2",3F13.2,
           1       /25X, "COORDINATES OF CORNER 3",3F13.2,
           2       /25X, "COORDINATES OF CORNER 4",3F13.2)
            PRINT 120
            PRINT 150
        150 FORMAT(19X, 10("        X"))
            PRINT 155, (TGRID(IX,IYZ,1),IX=IX1,IX2)
        155 FORMAT(19X, 10F9.2)
            PRINT 160
        160 FORMAT(19X, 10("  -------"))
            LINE = LINE + 4
      C-PRINT FOOTCANDLES
        200 JYZ = NUMYZ + 1 - IYZ
            PRINT 210, TGRID(IX1,JYZ,2),(TGRID(IX,JYZ,4),IX=IX1,IX2),
           1 TGRID(IX2,JYZ,2)
        210 FORMAT(10X, "Y", F8.2, 10F9.4, F8.2, " Y")
            PRINT 220, TGRID(IX1,JYZ,3),TGRID(IX2,JYZ,3)
        220 FORMAT(10X, "Z", F8.2, 90X, F8.2, " Z")
            PRINT 120
            LINE = LINE + 3
            GO TO 110
      C-END OF GRID PRINT
        300 CONTINUE
            RETURN
            END
```

```
C-SUBROUTINE FOR TWO-DIMENSIONAL INTERPOLATION
      SUBROUTINE INT2V (XBAR,YBAR,VAL)
      COMMON /T2V/ X(40),Y(40),TBL(40,40),HV,FID,NX,NY
      COMMON /T2V/ CM(6,4)
      NN=0
      JX=NX-1
      JY=NY-1
      DO 1 IX=1,JX
      IF (XBAR.EQ.X(IX)) GO TO 4
      IF ((XBAR.GT.X(IX)).AND.(XBAR.LT.X(IX+1))) GO TO 3
    1 CONTINUE
      IX = NX
      XIF = XBAR - X(IX)
      IF(ABS(XIF) .LT. .1) XIF = 0.
      IF(XIF) 2,4,2
    2 VAL=0.
      RETURN
    3 NN=1
    4 DO 5 IY=1,JY
      IF(YBAR.EQ.Y(IY)) GO TO 7
      IF ((YBAR.GT.Y(IY)).AND.(YBAR.LT.Y(IY+1))) GO TO 6
    5 CONTINUE
      IY = NY
      YIF = YBAR - Y(IY)
      IF(ABS(YIF) .LT. .1) YIF = 0.
      IF(YIF) 2,7,2
    6 NN=NN+2
    7 IF (NN) 2,8,9
    8 VAL=TBL(IX,IY)
      RETURN
    9 TEMP1=(XBAR-X(IX))/(X(IX+1)-X(IX))
      IF (NN-1) 2,10,11
   10 VAL=TBL(IX,IY)+TEMP1*(TBL(IX+1,IY)-TBL(IX,IY))
      RETURN
   11 TEMP2=(YBAR-Y(IY))/(Y(IY+1)-Y(IY))
      IF (NN-2) 2,12,13
   12 VAL=0.
      IF(TBL(IX,IY).NE.0.)VAL=TBL(IX,IY)+TEMP2*(TBL(IX,IY+1)/TBL(IX,IY))
      RETURN
   13 TEMP3=TBL(IX,IY)+TEMP1*(TBL(IX+1,IY)-TBL(IX,IY))
      TEMP4=TBL(IX,IY+1)+TEMP1*(TBL(IX+1,IY+1)-TBL(IX,IY+1))
      TEMP5=(YBAR-Y(IY))/(Y(IY+1)-Y(IY))
      TVAL1=TEMP3+TEMP5*(TEMP4-TEMP3)
      VAL =TVAL1
      RETURN
      END
```

```
C-THIS FUNCTION CALCULATES INVERSE TANGENTS SUCH THAT 0 =ATANSP =2*PI
      FUNCTION ATANSP(X,Y)
      COMMON /CONV/ PI,DEGRAD,RADDEG,PIO2
      IF((X.EQ.0.).AND.(Y.EQ.0.)) GO TO 10
      IF((X.EQ.0.).AND.(Y.GE.0.)) GO TO 20
      IF((X.EQ.0.).AND.(Y.LT.0.)) GO TO 30
      IF((X.GT.0.).AND.(Y.GE.0.)) GO TO 40
      IF((X.LT.0.).AND.(Y.GE.0.)) GO TO 50
      IF((X.LT.0.).AND.(Y.LT.0.)) GO TO 50
      IF((X.GT.0.).AND.(Y.LT.0.)) GO TO 60
      PRINT 5
    5 FORMAT(10X, "ERROR-ATANSP")
   10 ATANSP = 0.
      GO TO 70
   20 ATANSP = PIO2
      GO TO 70
   30 ATANSP = 3.*PI/2.
      GO TO 70
   40 ATANSP = ATAN(Y/X)
      GO TO 70
   50 ATANSP = PI+ATAN(Y/X)
      GO TO 70
   60 ATANSP = 2.*PI + ATAN(Y/X)
   70 RETURN
      END
```

```
C-THIS SUBROUTINE PRINTS POINTS, ONE PER CALL
      SUBROUTINE PTPRNT(IX,IYZ,XG,YG,ZG,HXY,H,V,CPL,R,RH,FC,NHEAD)
      COMMON /PID/ IPID(15),IPAGE,LINLIM,LINE
      IF(NHEAD .GT. 0) PRINT 110
      IF(LINE .LT. LINLIM) GO TO 120
      CALL PAGE
      PRINT 110
  110 FORMAT(/23X, "        X          Y          Z       HXY        H        V
     1   CP          R        RH                 FC")
      LINE = LINE + 2
  120 PRINT 130, IX,IYZ,XG,YG,ZG,HXY,H,V,CPL,R,RH,FC
  130 FORMAT(10X,"GRID ",2I3," (",3F8.2,")",6F8.2,F16.8)
      LINE = LINE + 1
      NHEAD = 0
      RETURN
      END
```

```
C-DIRECTION COSINES FOR HORIZONTAL POLAR AXIS
      SUBROUTINE COSFLD(H,V)
      COMMON /CON/ PI,DEGRAD,RADDEG,PID2
      COMMON /XYZ/ COSXX,COSXY,COSXZ,COSYX,COSYY,COSYZ,COSZX,COSZY,COSZZ
      SINV = SIN(V)
      SINH = SIN(H)
      COSV = COS(V)
      COSH = COS(H)
      PID2V = PID2 + V
      SPID2V = SIN(PID2V)
      CPID2V = COS(PID2V)
C-DIRECTION COSINES FOR X-AXIS
      COSXX = SINV * COSH
      COSXY = SINV * SINH
      COSXZ = COSV
C-DIRECTION COSINES FOR Y-AXIS
      COSYX = SPID2V * COSH
      COSYY = SPID2V * SINH
      COSYZ = CPID2V
C-DIRECTION COSINES FOR Z-AXIS
      COSZX = -SINH
      COSZY = COSH
      COSZZ = 0.
      RETURN
      END
```

```
C-DIRECTION COSINES FOR VERTICAL POLAR AXIS
      SUBROUTINE COSROD(H,V)
      COMMON /CON/ PI,DEGRAD,RADDEG,PID2
      COMMON /XYZ/ COSXX,COSXY,COSXZ,COSYX,COSYY,COSYZ,COSZX,COSZY,COSZZ
      SINV = SIN(V)
      SINH = SIN(H)
      COSV = COS(V)
      COSH = COS(H)
      VPID2 = V - PID2
      SVPID2 = SIN(VPID2)
      CVPID2 = COS(VPID2)
C-DIRECTION COSINES FOR X-AXIS
      COSXX = SINV * COSH
      COSXY = SINV * SINH
      COSXZ = COSV
C-DIRECTION COSINES FOR Y-AXIS
      COSYX = -SINH
      COSYY = COSH
      COSYZ = 0.
C-DIRECTION COSINES FOR Z-AXIS
      COSZX = SVPID2 * COSH
      COSZY = SVPID2 * SINH
      COSZZ = CVPID2
      RETURN
      END
```

```
      C-SUBROUTINE FOR CALCULATING         RMIT  RATIO
            SUBROUTINE AVPRNT
            COMMON /GRD/ TGRID(30,30,4),NUMX,NUMYZ
            FCT = 0.
            FCMIN = 9999999999.
            FCMAX = -9999999999.
            DO 110 I = 1,NUMX
            DO 110 J = 1,NUMYZ
            FCG = TGRID(I,J,4)
            IF(FCG .LT. FCMIN) FCMIN = FCG
            IF(FCG .GT. FCMAX) FCMAX = FCG
            FCT = FCT + FCG
        110 CONTINUE
            PTS = NUMX * NUMYZ
            PRINT 120, FCT, PTS
        120 FORMAT(//10X,"TOTAL FOOTCANDLES    =", F15.10
           1         /10X,"NUMBER OF POINTS     =", F15.10)
            FCA = FCT/PTS
            UNI = 0.
            IF(FCMIN .NE. 0.) UNI = FCA/FCMIN
            PRINT 130, FCA, UNI
        130 FORMAT(//10X,"AVERAGE FOOTCANDLES =", F15.10
           1         /10X,"UNIFORMITY RATIO    =", F15.10)
            PRINT 140, FCMAX, FCMIN
        140 FORMAT(//10X,"MAXIMUM FOOTCANDLES =", F15.10
           1         /10X,"MINIMUM FOOTCANDLES =", F15.10)
            RETURN
            END
```

```
      C-DISK DIRECTORY PRINT
            SUBROUTINE DRPRNT
            COMMON /PID/ IPID(15),IPAGE,LINLIM,LINE
            COMMON /IDX/ ANDEX1(200), INDEX1(800)
            NUMLUM = ANDEX1(200)
            IA1 = -3
        100 CALL PAGE
            PRINT 110
        110 FORMAT(/)
            PRINT 120
        120 FORMAT(10X,4("NO. LUMID        "))
            PRINT 130
        130 FORMAT(10X,4("--- ----------   "))
            LINE = LINE + 3
        140 IF(LINE .GT. LINLIM) GO TO 100
            IA1 = IA1 + 4
            IF(IA1 .GT. NUMLUM) GO TO 9990
            IA2 = IA1 + 3
            IF(IA2 .GT. NUMLUM) IA2 = NUMLUM
            PRINT 150, (IA,ANDEX1(IA),IA=IA1,IA2)
        150 FORMAT(10X,4(I3,1X,A10,2X))
            LINE = LINE + 1
            GO TO 140
       9990 RETURN
            END
```

12-1

```
C-SUBROUTINE FOR CHANGING PAGES AND RESETING LINE COUNTER
      SUBROUTINE PAGE
      COMMON /PID/ IPID(15),IPAGE,LINLIM,LINE
      COMMON /ISW/ ISW1,ISW2,ISW3,ISW4,ISW5,ISW6
      DATA ITOP/7656B/, IDEL/7674B/, IFLAG/0/
      IF(IFLAG .GT. 0) GO TO 80
      IFLAG = 1
      CALL DATE(PDATE)
      CALL TIME(PTIME)
   80 CONTINUE
      IPAGE = IPAGE + 1
      IF(ISW6 .NE. 0) PRINT 90, ITOP,(IDEL,IA=1,51)
   90 FORMAT(52R2)
      PRINT 100
  100 FORMAT(1H1)
      PRINT 110, IPID,PDATE,PTIME,IPAGE
  110 FORMAT(/   10X,15A4,20X,2(A9,1X,),"  PAGE",I5/)
      LINE = 4
      RETURN
      END
```

```
C-RETRIEVES A SPECIFIED CANDLEPOWER TABLE FROM MASS STORAGE
      SUBROUTINE RANIN(ITABLE)
      COMMON /T2V/ CPH(40),CPV(40),CP(40,40),HV,FID,NH,NV
      COMMON /T2V/ CMI(6,2)
      COMMON /DEV/ IDEV1,IDEV2,IDEV3,IDEV4,IDEV5,IDEV6
      COMMON /IDX/ ANDEX1(200),INDEX1(800)
      DIMENSION CPID(3500),CMID(28)
      EQUIVALENCE (CP,CPID), (HV,CMID)
      HV = 1HR
      FID = 10HBBBBBBBBBB
      NH = 0
      NV = 0
      DO 110 JA = 1,40
      CPH(JA) = 0.
      DO 110 IA = 1,40
  110 CP(IA,JA) = 0.
      DO 120 IA = 1,40
  120 CPV(IA) = 0.
      CALL RANREC(ITABLE,1,IREC)
      CALL READMS(IDEV1,CMID,28,IREC)
      CALL RANREC(ITABLE,2,IREC)
      CALL READMS(IDEV1,CPH,NH,IREC)
      CALL RANREC(ITABLE,3,IREC)
      CALL READMS(IDEV1,CPV,NV,IREC)
      NHNV = NH*NV
      CALL RANREC(ITABLE,4,IREC)
      CALL READMS(IDEV1,CPID,NHNV,IREC)
      IA = NHNV + 1
      JB = NV + 1
      DO 210 JA = 1,NV
      JB = JB - 1
      IB = NH + 1
      DO 210 IC = 1,NH
      IA = IA - 1
      IB = IB - 1
      CP(IB,JB) = CPID(IA)
      IF(IA .GT. NH) CPID(IA) = 0.
  210 CONTINUE
      RETURN
      END
```

```
C-THIS SUBROUTINE PRINTS THE CANDLEPOWER TABLE FOR A LUMINAIRE
      SUBROUTINE CPPRNT(ITABLE)
      COMMON /T2V/ CPH(90),CPV(40),CP(90,40),HV,FID,NH,NV
      COMMON /T2V/ CM(6,4)
      COMMON /PID/ IPID(15),IPAGE,LINLIM,LINE
      COMMON /CON/ PI,DEGRAD,RADDEG,PID2
      DIMENSION H(90),V(40),ICP(10)
      CALL RANIN(ITABLE)
      DO 110 IA = 1,NH
  110 H(IA) = CPH(IA) * RADDEG
      DO 120 JA = 1,NV
  120 V(JA) = CPV(JA) * RADDEG
      JB = 0
C-CHANGE PAGE AND PRINT HEADINGS
  210 CALL PAGE
      PRINT 220, FID,ITABLE
  220 FORMAT(10X,"CANDLEPOWER TABLE - LUMINAIRE CODE: ",
     2    A10,1X,"TABLE NO.",I4)
      DO 230 JA = 1,4
  230 PRINT 240, (CM(IA,JA),IA=1,6)
  240 FORMAT(10X,6A10)
      PRINT 250
  250 FORMAT(1H )
      PRINT 260, HV,NH,NV
  260 FORMAT(10X,"HORZ. ANGLES",2X,"(",A1,2I5,")")
      LINE = LINE + 7
      IA1 = 1
      IA2 = 9
      IF(IA2 .GT. NH) IA2 = NH
      PRINT 270, (H(IA),IA=IA1,IA2)
      LINE = LINE + 1
  270 FORMAT(16X,9F6.1)
      IA1 = 0
  280 IA1 = IA1 + 10
      IF(IA1 .GT. NH) GO TO 310
      IA2 = IA1 + 9
      IF(IA2 .GT. NH) IA2 = NH
      PRINT 290, (H(IA),IA=IA1,IA2)
      LINE = LINE + 1
  290 FORMAT(10X,10F6.1)
      GO TO 280
C-PRINT BODY OF TABLE
  310 PRINT 320
  320 FORMAT(5X,"VERT.")
      LINE = LINE + 1
  330 IF((LINE .GT. LINLIM) .AND. (JB .LT. NV)) GO TO 210
      JB = JB + 1
      IF(JB .GT. NV) GO TO 9990
      IA1 = 1
      IA2 = 9
      IF(IA2 .GT. NH) IA2 = NH
      IB2 = 0
      DO 339 IA = IA1,IA2
      IB2 = IB2 + 1
  339 ICP(IB2) = CP(IA,JB)
      PRINT 340, V(JB),(ICP(IB),IB=1,IB2)
      LINE = LINE + 2
```

```
  340 FORMAT(/4X,F6.1,5X,9I6)
      IA1 = 0
  350 IA1 = IA1 + 10
      IF(IA1 .GT. NH) GO TO 330
      IA2 = IA1 + 9
      IF(IA2 .GT. NH) IA2 = NH
      IB2 = 0
      DO 359 IA = IA1,IA2
      IB2 = IB2 + 1
  359 ICP(IB2) = CP(IA,JH)
      PRINT 360, (ICP(IH),IH=1,IB2)
      LINE = LINE + 1
  360 FORMAT(10X,10I6)
      GO TO 350
 9990 RETURN
      END
```

```
C-SUBROUTINE FOR COMPUTING CDC RECORD NUMBER
      SUBROUTINE RANREC(IG,IT,IR)
      IR = 4*(IG-1) +IT + 1
      RETURN
      END
```

ELECTRONIC COMPUTER PROGRAM ABSTRACT

TITLE OF PROGRAM Point to Point Lighting			PROGRAM NO 712X602120
PREPARING AGENCY U.S. Army Corps of Engineers, Omaha District			
AUTHOR(S) M.E. Fletcher	DATE PROGRAM COMPLETED Sep 75 Mar 77	STATUS OF PROGRAM PHASE REV 1	STAGE PROD

A. PURPOSE OF PROGRAM

The program analyzes the design of a lighting installation to determine the amount of illumination it gives. The program permits analysis of an installation having many luminaires. The luminaires may be a mixture of many different types.

B. PROGRAM SPECIFICATIONS

1. Language - FORTRAN IV
2. Size: 23.042K Words

C. METHODS

The program performs lighting calculations by the point to point method. The candlepower data for many different luminaires has been previously stored on random access disk. When calculations are being for a particular luminaire the candlepower table for that luminaire is placed in memory. The horizontal component, or vertical component, or direct illumination may be selected for output.

D. EQUIPMENT DETAILS

1. Computer: CDC 6600
2. Peripherals: 1-Card Reader
   1-Printer
   1-Random Access Disk

E. INPUT - OUTPUT

INPUT: Usually a permanent file created for timesharing terminal by using the text editor.

OUTPUT: Runs are submitted from the timesharing terminal, and output returned at the remote batch terminal.

F. ADDITIONAL REMARKS

POINT TO POINT LIGHTING 712C2120

*****

1. IDENTIFICATION.
   Program name: Point To Point Lighting
   Program number: 712X6C2120
   Original: September 1975
   Revision: 1 - March 1977. This revision changed the method of specifying the test grid. It also incorporates other changes and improvements necessary for the program to operate in a combination timesharing and remote batch system.

2. PURPOSE. The program analyzes the design of a lighting installation to determine the amount of illumination it gives. The design is described to the program by giving the coordinates of each luminaire. The origin of the coordinate system is completely arbitrary. It may be chosen wherever convenient. The output of the program is a printout of a grid of illumination (footcandle) values. The grid is specified by giving the coordinates of two corners.

3. ENTERING CANDLEPOWER DATA. Refer to Figure 3, card type 50. In order to test a given luminaire with this program the candlepower data for the luminaire must be obtained and entered into the computer. For use with this program candlepower data must be in the form of a two-dimensional table; one dimension being the number of horizontal angles, the other dimension being the number of vertical angles.

3.1. The candlepower data is first entered into a sequential file which has a format of one record (card) per point. The program will later transfer the data to a random access file. The first 9 characters of a record are ignored by the program, and may be used for sequence numbers or other information at the discretion of the user. Character 10 must contain either an H or V. This indicates to the program how the photometry of the fixture was performed, i.e. was the polar axis horizontal or vertical (polar axes will be discussed later). Columns 11-20 contain the LUMID. Columns 21-30 contain the horizontal angle. Columns 31-40 contain the vertical angle. Columns 41-50 contain the candlepower value.

3.2. The cards must be arranged so the the angles are in

ascending order with the vertical angles changing the fastest. The resulting file has a group of cards with the same horizontal angle, and with the vertical angles increasing from the smallest to the largest. This group is then followed by another group with the next larger horizontal angle, and a repetition of the vertical angles. The pattern is followed until all data for the luminaire has been entered.

3.3. Since photometric data is given in terms of horizontal and vertical angles a polar coordinate system is implied. It is very important to determine if the photometry was performed with a horizontal or a vertical polar axis. Consider for a minute the standard right-handed XYZ coordinate system. Polar coordinates in such a system are given by r, theta, and phi. It is not necessary to specify the coordinate r for a candlepower table. Theta is the angle with the positive Z-axis. Phi is the angle with the positive X-axis. Let r = 1 unit so that we are considering a unit vector with some direction designated by theta and phi. If phi is held constant at some value, and theta is varied from 0.0 to 360.0 degrees then the tip of the unit vector will trace a great circle on a sphere of radius 1. This corresponds to a line of longitude of the surface of the earth. If theta instead of phi is held constant, and phi is varied from 0.0 to 360.0 degrees then the tip of the unit vector will trace a circle smaller than a great circle unless theta is exactly 90.0 degrees. These circles correspond to lines of latitude on the earth.

3.4. The program defines the Z-axis as the polar axis of an XYZ-coordinate system. When preparing to enter candlepower data it is necessary to determine whether the polar axis was horizontal or vertical when the photometric tests were made. This determines whether the horizontal angles in the candlepower table are measuring lattitude or longitude. If that question is answered for horizontal angles then it is automatically answered for vertical angles.

3.5. In general for floodlight type luminaires it will be found that the photometric data was taken with the polar axis horizontal. This means that the

candlepower data should be coded with an H.

3.6. In general for roadway type luminaires it will be found that the photometric data was taken with the polar axis vertical. This means that the candlepower data should be coded with a V.

3.7. For entering candlepower data certain conventions have been adopted which do not necessarily conform to standard mathematical usage.

3.8. For a luminaire coded as H, generally a floodlight luminaire, the following convention has been adopted: For horizontal angles the zero reference is taken 90 degrees to the left of the central part of the beam when looking at the face of the luminaire. Most floodlights have a bracket which permits tilting in the vertical direction. A ray with a horizontal angle of 0.0 degrees would come out the right hand shaft of the vertical tilt mechanism when looking at the luminaire from behind. For vertical angles the zero reference is taken at the central part of the beam. Angles below the center of the beam are positive, and become increasingly more positive as the rotation down from the center of beam increases. Angles above the center of the beam are negative, and beome increasingly more negative as the rotation up from the center of the beam increases.

3.9. For a luminaire coded a V, generally a roadway luminaire, the following convention has been adopted: Draw a line from the mounting bracket out through the center of the luminaire. The zero reference for horizontal angles is on a line through the center of the luminaire, perpendicular to the bracket-luminaire line, and to the right when looking at the luminaire from behind. A point on the bracket-luminaire line on the opposite side from the bracket would have a horizontal angle of 90.0 degrees. The zero reference for vertical angles is a horizontal plane through the center of the luminaire. A point in this plane has a vertical angle of 0.0 degrees. A point directly beneath the luminaire has vertical angle of positive 90.0 degrees. The point directly beneath a roadway luminaire is ambiguous as far as the horizontal angle is concerned. This point has been arbitrarily

assigned a horizontal angle of [illegible] degrees.

3.10. Please note that these conventions apply [illegible] to the angles used for entering [illegible] [illegible] apply to aiming angles and to other angles to be discussed later. They are not necessarily consistent with manufacturer's data sheets either. Some manual conversion of angles must usually be made before the candlepower data is entered. There is no single inclusive reporting format [illegible] to all luminaires so manufacturers' information will be found presented in many different ways.

3.11. A special case which needs to be mentioned is a roadway luminaire model which has its lights at all horizontal angles from [illegible] to [illegible] degrees. The candlepower table for this type of luminaire must include columns for both [illegible] and [illegible] degrees. This is required to make the two-dimensional interpolation routine work properly.

4. ENTERING DEPRECIATION FACTORS. Refer to Figure 2, card type 40. The amount of light a given luminaire will put out when it is new and clean is greater than it will be after some time has passed. For design purposes it is usually desired to predict the performance of the lighting system under the worst possible conditions. In most cases the worst possible conditions would be just before lamp replacement and just before cleaning. The program predicts a decrease in light by applying multipliers to the candlepower of the luminaire. The multipliers are decimal fractions in the range 0.0<FACTOR<=1.0.

4.1. The program allows for three factors. One is for lamp aging. One is for dirt accumulation. The last factor is for anything else that needs to be considered such as a lamp with a different lumen rating than the lamp used in the photometric tests.

Data definitions:

CPL = The candlepower of the luminaire with no depreciation factors applied. CPL is interpolated from the nearest values in the previously entered candlepower table.

DDIRT = The depreciation factor due to the

14-5

accumulation of dirt on the luminaire.

DLAMP = The depreciation factor due to aging of the lamp.

OTHFC = Any other factor which must considered, and will change light output.

Computation: CPL * DLAMP * DDIRT * OTHFC

5. ENTERING LUMINAIRE POSITION AND AIMING. Refer to Figure 2, card type 60. The exact position of each luminaire as well its aiming angles must be entered. The positions that are entered are the positions of the center of each luminaire. In addition to the X and Y coordinates, the Z-coordinate or height of the luminaire must be given. The Z-coordinate would normally be the pole height. A situation where the Z-coordinate would not be the pole height would be in the case of a roadway luminaire mounted on an arm with upward slant. The increased height due to slant must be included. The actual height above ground of the luminaire is the correct figure in all cases.

5.1. The location of the origin of the coordinate system is completely relative. The user simply has to make sure that all coordinates that he enters are consistent with the system that he is using. When the program computes the amount of light falling on a certain point the coordinates involved are subtracted, and the program operates with the differences.

Data Definitions:

XL, YL, ZL = The coordinates of the luminaire.

XG, YG, ZG = The coordinates of the point on the test grid.

Computation:
X = XG - XL
Y = YG - YL
Z = ZG - ZL

5.2. Aiming angles must also be entered. The system of coordinates used by the program is a standard right-hand XYZ-coordinate system. The Z-axis is

14-6

defined as being vertical. The horizontal aiming angle is measured from the positive X-axis. It can go all the way around from 0.0 to 360.0 degrees. Negative values are not allowed. The vertical aiming angle is measured from the negative Z-axis. This is contrary to the standard system which measures from the positive Z-axis. The result is that a vertical angle of 0.0 degrees indicates a light aimed straight down.

5.3. Before vertical angles are used in further calculations they are changed to other values. The translation depends upon whether the luminaire has been coded as H or V. For a luminaire coded as H (floodlight) vertical angles in the range 0.0 to 180.0 are changed to 180.0 to 0.0. This effectively switches the zero reference to the positive Z-axis. For a luminaire coded as V (roadway) vertical angles in the range 0.0 to 90.0 is changed to 90.0 to 0.0, and the range 90.0 through 180.0 is changed to 360.0 to 270.0.

6. ENTERING THE TEST GRID. Refer to Figure 2, card types 70 and 80. A test grid is defined as the network of points for which the amount of light is to be computed. The program is capable of processing as many test grids in one run as required. The specification of a test grid consists of a sequence of two cards defining a rectangular area. The sequence is repeated as often as necessary. It is sometimes useful to make a test grid covering a large area, and then to make another test grid covering a smaller area within the larger area.

6.1. A test grid is defined by giving the XYZ-coordinates of two points. The points are at opposite corners of a rectangular area. The area is the space for which the amount of light is to be computed. A geometric fact is that three points are required to define a plane. In the case of a horizontal plane (and tilted planes where the line from point 1 to 3 is parallel to the X-axis) the program will pick the third point automatically. Otherwise it is necessary to give the coordinates of the third point.

6.2. The rules the program uses to pick point 3 are as follows:

XGRID3 = XGRID2
YGRID3 = YGRID1
ZGRID3 = ZGRID1

With the above information the program calculates the coordinates of the fourth corner and all the remaining points of the test grid. The coordinates of the four corners are printed to help in interpreting the results.

6.3. When the test grid is printed out the positions of the corners on the paper are as follows: Corner 1 is lower left. Corner 2 is upper right. Corner 3 is lower right. Corner 4 is upper left.

6.4. The first card specifying the test grid is for the XYZ-coordinates of corner 1 and corner 2. The second card is for the number of X-points, the number of YZ-points, the selection of horizontal or vertical components or direct, the angle of the light meter for vertical components, and the XYZ-coordinates of corner 3.

7. METHODS: The following paragraphs discuss in detail the mathematical procedures the programs uses. Only enough detail was included to make the major points understandable. For more detail refer to the program listing itself.

8. After the input data discussed above is complete the program proceeds to calculate illumination at points on the test grid by the point to point method. This means that the distance and angles to a point on the test grid are determined, the candlepower looked up in the table, and the calculation made. The procedure is repeated once for each point on the test grid for each luminaire. The following formula will determine the exact number of times the procedure is carried out. Data definition:

NUNIT = the number of luminaires

NUMX = the number of X-points on the test grid

NUMYZ = the number of YZ-points on the test grid

IGRID = the total number of test grids to be processed

LOOPS = the number of time the procedure is performed

Computation: LOOPS = NUNIT * NUMX * NUMYZ * IGRID

9. At the beginning of the point to point calculation loop the program selects a particular luminaire. The aiming angles are adjusted as discussed above. Then it selects a particular point on the test grid. The luminaire and point selected depend on the number of times the program has been around the loop.

10. After the aiming angles have been adjusted the next item of business is calculation of the X, Y, and Z distances to the point. This is done by subtracting the coordinates of the test grid point and the luminaire. The XYZ-distances are used to calculate some other basic values. Data definition:

    R = the straight line distance from the luminaire to the point

    RH = the component of R in the horizontal plane

    HXY = the horizontal angle from the luminaire to the point in the main system

    COSZP = the cosine of the angle of the luminaire's ray with a vertical line

    Computation:
    R = SQRT(X*X + Y*Y + Z*Z)
    RH = SQRT(X*X + Y*Y)
    HXY = ATANSP(X,Y)
    COSZP = Z/R

11. After computation of R and the other basic items the program branches depending on whether the luminaire has a horizontal or vertical polar axis. The next step in either branch is calculation of direction cosines.

11.1. For a floodlight luminaire coded as H: A coordinate system is established about the luminaire. The polar axis (Z-axis) of the system is fixed in a horizontal position. Note below that COSZZ = 0. This fixes the Z-axis as parallel to the XY-plane but still allows it to rotate. The central part of the beam is aimed along the Y-axis. The direction cosines of the angles of the axes of the luminaire's

system with the axes of the main system are computed. Data definition:

H = horizontal aiming angle

V = vertical aiming angle

PID2 = pi/2 or 90.0 degrees

COSXX, COSXY, COSXZ = the cosines of the luminaire's X-axis with the main system's axes

COSYX, COSYY, COSYZ = the cosines of the luminaire's Y-axis with the main system's axes

COSZX, COSZY, COSZZ = the cosines of the luminaire's Z-axis with the main system's axes

Computation:

```
C-DIRECTION COSINES FOR X-AXIS
COSXX = SIN(V) * COS(H)
COSXY = SIN(V) * SIN(H)
COSXZ = COS(V)
C-DIRECTION COSINES FOR Y-AXIS
COSYX = SIN(PID2 + V) * COS(H)
COSYY = SIN(PID2 + V) * SIN(H)
COSYZ = COS(PID2 + V)
C-DIRECTION COSINES FOR Z-AXIS
COSZX = -SIN(H)
COSZY = COS(H)
COSZZ = 0.
```

11.2. For a roadway luminaire coded as V: A coordinate system is established about the luminaire. The polar axis (Z-axis) of the system is vertical. The central beam of the luminaire is aimed along the negative Z-axis. Computation of direction cosines:

```
C-DIRECTION COSINES FOR X-AXIS
COSXX = SIN(V) * COS(H)
COSXY = SIN(V) * SIN(H)
COSXZ = COS(V)
C-DIRECTION COSINES FOR Y-AXIS
COSYX = -SIN(H)
COSYY = COS(H)
COSYZ = 0.
C-DIRECTION COSINES FOR Z-AXIS
COSZX = SIN(V-PID2) * COS(H)
```

```
COSZY = SIN(V-PID2) * SIN(H)
COSZZ = COS(V-PID2)
```

12. After calculation of the appropriate set of direction cosines the coordinates of the test grid point in the luminaire's system are computed. The formula used is the standard one for rotation of coordinates in three dimensions. Data definition:

XC, YC, ZC = the coordinates of the test grid point in the lights system

Computation:

```
XC = COSXX*X + COSXY*Y + COSXZ*Z
YC = COSYX*X + COSYY*Y + COSYZ*Z
ZC = COSZX*X + COSZY*Y + COSZZ*Z
```

13. Once the coordinates in the luminaire's system have been computed they can be used to obtain the horizontal and vertical angles in the luminaire's system. Data definition:

VC = the vertical angle in the luminaire's system

HC = the horizontal angle in the luminaire's system

Computation:

```
VC = ACOS(ZC/R)
COSH = 1.
SINVC = SIN(VC)
IF(SINVC .NE. 0.) COSH = XC/(R*SINVC)
IF(COSH .GT. 1.) COSH = 1.
IF(COSH .LT. -1.) COSH = -1.
HC = ACOS(COSH)
IF(YC .LT. 0.) HC = PIX2 - HC
```

The purpose of the last IF statement is to allow the horizontal angle to cover the full range from 0.0 to 360.0 degrees. This is necessary since ACOS repeats on the range from 0.0 to 180.0 degrees.

14. After the angles have been computed in the luminaire's system further manipulation is still required before we have the angles necessary to reference the candlepower table. Different manipulations are performed depending on whether the luminaire is coded as H or V.

14.1. For a floodlight luminaire coded as H: The vertical

14-11

angle VC is turned into the horizontal angle H. H is used for the candlepower table look up. This change is necessary since the polar axis (Z-axis) of the luminaire's coordinate is horizontal. The horizontal angle HC is turned into the vertical angle V. Data definition:

PI = pi = 3.1416592

Computation:

```
H = PI - VC
IF((XC .LE.  0.) .AND.  (ZC .GT.  0.)) H = PI + VC
IF((XC .LT.  0.) .AND.  (ZC .LE.  0.)) H = PI + VC
V = -HC
IF(YC .LT.  0.) V = PIX2 - HC
V = -V
```

14.2. For a roadway luminaire coded as V: The vertical angle VC is turned into the vertical angle V, but the zero reference is switched from the positive Z-axis to the XY-plane. The horizontal angle HC is turned into the horizontal angle H. The 90.0 degrees added has the effect of making the line directly in front of the luminaire 90.0 degrees.

Computation:

```
H = HC + PID2
IF(H .GT.  PIX2) H = H - PIX2
V = VC - PID2
```

15. After the necessary angles have been computed the next step is the same for both types of luminaires. The step is to perform a table look up in the candlepower table using the horizontal and vertical angles H and V. Since there will not usually be an entry in the table at the exact angles needed it is necessary to perform a two-dimensional interpolation. In the program the whole buisness is accomplished by a subroutine called INT2V.

16. The interpolation proceeds in three steps. First a candlepower value is interpolated using the horizontal angles bracketing the point and the candlepower values at the nearest vertical angle below the point. Then another interpolation is performed using the candlepower values at the nearest vertical angle above the point. Then using the two candlepower values just obtained a value is interpolated using the vertical

angles bracketing the point. The result of the last interpolation is the final value of candlepower. It is used to calculate footcandles.

17. Computation of illumination:

FC = CPL * DLAMP * DDIRT * DIHFC/(R*R)

It is standard practice to resolve FC (footcandles) into either a horizontal or vertical component. This is necessary so that light from a number of different sources can be added.

17.1. For horizontal components. Data definition:

COSZP = the cosine of the angle of the luminaire's ray with a vertical line

Computation: FC = FC * ABS(COSZP)

17.2. For vertical components. Data definition:

HXY180 = the reverse of the horizontal angle from the luminaire to the point in the main system

HMETER = the angle the light meter is aimed

Computation:

```
FC = FC * RH/R
HXY180 = HXY + PI
IF(HXY180 .GT.  PIX2) HXY180 = HXY180 - PIX2
HV = HXY180 - HMETER
COSHV = COS(HV)
FC = FC * COSHV
IF(COSHV .LT.  0.) FC = 0.
```

18. The final value for the illumination (FC) obtained is added to the test grid point. The program then goes on to the next point. The program continues to go through the loop until it has done all the points and all the luminaires. Then the test grid is printed.

19. DESCRIPTION OF INPUT: The illustrations on the following pages show how input should be prepared. The term "card" is used loosely since the program can run either with card input or with input from a timesharing terminal. One line of typing on a terminal is equivalent to one card.

19.1. Formats are shown in the illustrations. The proper type of data must be typed in each field according to the field's format. If a mistake is made in the type of data in the field the program will abort. I format is for integer data. The data for an I field should be typed right justified without a decimal point. F format is for decimal numbers. The data for F fields should be typed right justified with a decimal point. A format is for alphabetic data. The data for A fields should be left justified. The particular columns allotted for the various data fields are shown by the illustrations.

19.2. Three types of cards require special attention. After the required number of these cards are entered there must be a kissoff. A kissoff card has all 9's from column 11 to column 20. The card types that require a kissoff are: luminaire depreciation factors, luminaire positions, test grid specifications.

19.3. An actual data set is reproduced in Figure 1 with comments.

14-14

```
00100 9999           1                         1 ← SWITCHES
00105      PADRUN3
00110      V10CHSGGE          1.00      1.00      1.00 ←DEPRECIATION FACTORS
00120      9999999999 ← KISSOFF
                                                       LUMINAIRE POSITION
00130      V10CHSGGE          0.00      0.00     20.00      0.00      0.00
00140      9999999999 ← KISSOFF
                                                       TEST GRID SPECIFICATION
00150          -10.00       -10.00      0.00     10.00     10.00      0.00
00160               5            5         H      0.00
00170      9999999999 ← KISSOFF
*
```

FIGURE 1 - INPUT PREPARED ON A TIMESHARING TERMINAL

PUNCHED CARD FORMAT—MULTIPLE

DATE: MARCH 1977 | JOB NUMBER: 712-MIC2-120 | PROG./ANL: M.E. TOHER

TITLE: POINT TO POINT LIGHTING

SOURCE: FIGURE 2 - DESIGN DATA INPUT FORMAT

CARD TYPE 10 - PROGRAM CONTROL

NOTE: ALL SWITCHES READ BY I10 FORMAT 1=ON, 0=OFF.

10

Columns	1–10	11–20	21–30	31–40	41–50	51–60	61–70
Field	ITYPE	ISW1	ISW2	ISW3	ISW4	ISW5	ISW6
Meaning		PRINT CANDLE-POWER TABLE	DISK DIRECTORY PRINT	PRINT EACH POINT AFTER CALCULATION	PRINT GRID AFTER EACH LIGHT	PRINT EACH CANDLE POWER CARD	READ SEQUENTIAL CANDLE POWER FILE

CARD TYPE 30 - PROJECT IDENTIFICATION

30

Columns	1–10	11–70
Field	ITYPE	IPID (60 CHARACTERS ALPHANUMERIC) 15A4

CARD TYPE 40 - LUMINAIRE IDENTIFICATION & DEPRECIATION FACTORS

40

Columns	1–10	11–20	21–30	31–40	41–50
Description		LUMINAIRE IDENTIFICATION	LAMP LUMEN DEPRECIATION	LUMINAIRE DIRT DEPRECIATION	ANY OTHER FACTOR
Field	ITYPE	LUMID 2A4, A2	DLAMP F10.0	DDIRT F10.0	OTHFC F10.0

CARD TYPE 60 - LUMINAIRE POSITION AND ORIENTATION

60

Columns	1–10	11–20	21–30	31–40	41–50	51–60	61–70
Field	ITYPE	LUMID F10.0	XLUM F10.0	YLUM F10.0	ZLUM F10.0	HLUM F10.0	VLUM F10.0

CARD TYPE 70 - TEST GRID SPECIFICATION

70

Columns	1–10	11–20	21–30	31–40	41–50	51–60	61–70
Field	ITYPE	XGRID1 F10.0	YGRID1 F10.0	ZGRID1 F10.0	XGRID2 F10.0	YGRID2 F10.0	ZGRID2 F10.0

CARD TYPE 80 - TEST GRID SPECIFICATION

80

Columns	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
Field	ITYPE	NUMX I10	NUMYZ I10		H, V, D (ICOMP, A1) / HMETER F10.0	XGRID3 F10.0	YGRID3 F10.0	ZGRID3 F10.0

REMARKS

p. 14-16

PUNCHED CARD FORMAT—MULTIPLE

TITLE	DATE	JOB NUMBER	PROGRAMMER
POINT TO POINT LIGHTING	MARCH 1977	712-MIC2-120	M.E. FLETCHER
	SOURCE: FIGURE 3 - CANDLEPOWER INPUT FORMAT		

CARD TYPE 50 - LUMINAIRE CANDLEPOWER DISTRIBUTION

Columns 1-3	Columns 4-8	Column 9	Columns 10-20	Columns 21-30	Columns 31-40	Columns 41-50	Columns 51-80
50		IPOLAR H,V		HORIZONTAL ANGLE	VERTICAL ANGLE	CANDLEPOWER	
ITYPE		I	LUMID 2A4,A2	HANG F10.0	VANG F10.0	CP F10.0	

REMARKS

1918a

P14-17

NOTES:

1. IN THIS REVISION OF THE PROGRAM CANDLEPOWER DATA IS READ FROM EITHER TAPE 1 OR TAPE 2 DEPENDING ON THE VALUE SWITCH 6.

2. IF SWITCH 6 IS OFF (ZERO), WHICH IS THE NORMAL MODE, CANDLEPOWER DATA IS READ FROM TAPE 1. TAPE 1 IS A BINARY, RANDOM ACCESS FILE. IT IS NOT POSSIBLE TO MAKE ANY CHANGES THIS FILE EXCEPT FOR A TOTAL RE-CREATION.

3. IF SWITCH 6 IS ON (ONE) CANDLEPOWER DATA IS READ FROM TAPE 2 AND WRITTEN TO TAPE 1. TAPE 2 IS A BCD FILE FORMATED AS SHOWN ABOVE. IT CAN CHANGED WITH THE TEXT EDITOR (COMPOSE) OR OTHER PROGRAMS. IT COULD ALSO BE PUNCHED INTO CARDS OR READ FROM CARDS.

4. ON HDR'S SYSTEM A PERMANENT FILE CALLED CANDLE1 IS MAINTAINED. CANDLE1 IS ASSIGNED TO TAPE 2. ANOTHER PERMANENT FILE CANDLER IS ASSIGNED TO TAPE 1. THERE IS A PROCEDURE FILE, LIGHT1R, WHICH CAN BE SUBMITTED TO TRANSFER THE CANDLEPOWER DATA FROM CANDLE1 TO CANDLER.

5. THE SEQUENTIAL CANDLEPOWER FILE MUST END WITH A KISSOFF (9999999999) IN COLUMNS 11-20. THIS IS THE FILE CANDLE1 ON TAPE2.

```
/LIST
C-U.S. ARMY CORPS OF ENGINEERS
C-OMAHA DISTRICT
C
C-OUTDOOR LIGHTING ECONOMIC COMPARISON, 712MIC2130
C-AUTHOR: M. E. FLETCHER
C-DATE: OCTOBER 1975
C
      PROGRAM ECON1(TAPE1,OUTPUT,TAPE2=OUTPUT)
      COMMON /EQP/ F2(6),F3(6),F5(6),F7(6),F8(6),F9(6),
     1F12(6),F13(6),F14(6),F14A(6),F14C(6),F15(6),
     2F16(6),F6(6),I1(6),I4(6),I10(6),I11(6)
      COMMON /LAB/ F18(6),F19(6),F20(6),F21(6),F21A(6),F21B(6),F22(6),
     1F23(6)
      COMMON /ILL/ F25(6),F26(6),F27(6),F28(6),F28A(6),F29(6),F29A(6)
      COMMON /CST/ F30(6),F30A(6),F31(6),F32(6),F33(6),F34(6),
     1F35(6),F36(6),F37(6),F37D(6),F38(6),F38A(6),F38B(6),F39(6),F40(6)
      COMMON /MNT/ F43(6),F43A(6),F44(6),F46(6),F47(6),F48(6),F50(6),
     1F51(6),F52(6),F53(6),F54(6),F54A(6)
      COMMON /ANN/ F55(6),F56(6),F57(6),F57A(6),F58(6)
      COMMON /TOT/ I1T(30),F3T(30),I4T(30),F7T(30),F9T(30),F13T(30),
     1 F14T(30),F14AT(30),F14CT(30),F15T(30),F16T(30),F20T(30),F21T(30),
     2 F23T(30),F33T(30),F31T(30),F37T(30),F37DT(30),F40T(30),F44T(30),
     3 F47T(30),F50T(30),F51T(30),F52T(30),F53T(30),F55T(30),F56T(30),
     4 F22T(30),F21AT(30),F21BT(30),F36T(30),F29T(30),F17(30),F24(30),
     5 F59C(30),F59(30),F60(30),F54T(30),F58T(30)
      COMMON /HED/ HEAD(5,4),SYSCOL(130),DESCRI(5,120),ISYS
      COMMON /DEV/ IDEV1
C-DEVICE CODES
      IDEV1 = 1
      REWIND IDEV1
      ISYS = 0
      SPACES = 10H
      HEAD(1,1) = SPACES
      HEAD(1,2) = SPACES
      HEAD(1,3) = 10H TOTAL FOR
      HEAD(1,4) = 10H SYSTEM
C-READ HEADING FOR SIDE BY SIDE COMPARISION
  100 ISYS = ISYS + 1
      CALL ZERO
      J = (ISYS - 1) * 4
      DO 120 K = 1,4
      J = J + 1
      READ(IDEV1,110) SYSCOL(J),(DESCRI(I,J),I=1,5)
  110 FORMAT(10X,6A10)
      IF(EOF(IDEV1)) 4000,120
  120 CONTINUE
C-READ DATA FOR COLUMN HEADERS
      DO 140 IL=1,4
      READ(IDEV1,130) (HEAD(IG,IL),IG=2,5)
  130 FORMAT(10X,6A10)
```

PRINTOUT OF COMPUTER PROGRAM USED FOR ECONOMIC COMPARISONS

ATTACHMENT 15

```
      IF(EOF(IDEV1)) 9999,140
  140 CONTINUE
C-READ THE NUMBER OF COMPONENT GROUPS FOR THIS SYSTEM
      READ(IDEV1,150) NUMG
  150 FORMAT(10X,I10)
C
C-I. INITIAL EQUIPMENT INVESTMENT
C
      CALL PAGE(1)
      PRINT 190
  190 FORMAT(/10X,'I.  INITIAL EQUIPMENT INVESTMENT'/)
C-1. QUANTITY OF LUMINAIRES
  200 READ(IDEV1,210) I1
  210 FORMAT(10X,6I10)
      CALL ITOTER(I1,I1T(ISYS))
      PRINT 240, I1T(ISYS),(I1(IG),IG=1,NUMG)
  240 FORMAT(10X,'  1.  QUANTITY OF LUMINAIRES                 ',5I14)
C-2. LUMINAIRE COST EACH
      READ(IDEV1,250) F2
  250 FORMAT(10X,6F10.0)
      PRINT 260, (F2(IG),IG=1,NUMG)
  260 FORMAT(10X,'  2.  LUMINAIRE COST EACH                    ',14X,4F14.2)
C-3. LUMINAIRE COST TOTAL
      DO 270 IG=1,NUMG
      FI1 = I1(IG)
      F3(IG) = FI1*F2(IG)
  270 CONTINUE
      CALL FTOTER(F3,F3T(ISYS))
      PRINT 280, F3T(ISYS),(F3(IG),IG=1,NUMG)
  280 FORMAT(10X,'  3.  LUMINAIRE COST TOTAL                   ',5F14.2)
C-4. QUANTITY OF POLES
      READ(IDEV1,210) I4
      CALL ITOTER(I4,I4T(ISYS))
      PRINT 290, I4T(ISYS),(I4(IG),IG=1,NUMG)
  290 FORMAT(10X,'  4.  QUANTITY OF POLES                      ',5I14)
C-5. MOUNTING HEIGHT
      READ(IDEV1,250) F5
      PRINT 300, (F5(IG),IG=1,NUMG)
  300 FORMAT(10X,'  5.  MOUNTING HEIGHT                        ',14X,4F14.2)
C-6. POLE + BRACKET COST
      READ(IDEV1,250) F6
      PRINT 310, (F6(IG),IG=1,NUMG)
  310 FORMAT(10X,'  6.  POLE + BRACKET COST EACH               ',14X,4F14.2)
C-7. POLE COST TOTAL
      DO 320 IG=1,NUMG
      FI4 = I4(IG)
      F7(IG) = FI4*F6(IG)
  320 CONTINUE
      CALL FTOTER(F7,F7T(ISYS))
      PRINT 330, (F7(IG),IG=1,NUMG)
  330 FORMAT(10X,'  7.  POLE COST TOTAL                        '14X,4F14.2)
C-8. FOUNDATION COST EACH
      READ(IDEV1,250) F8
      PRINT 340, (F8(IG),IG=1,NUMG)
  340 FORMAT(10X,'  8.  FOUNDATION COST EACH                   ',14X,4F14.2)
C-9. POLE + FOUNDATION COST TOTAL
      DO 350 IG=1,NUMG
      FI4 = I4(IG)
      F9(IG) = FI4*(F6(IG)+F8(IG))
  350 CONTINUE
      CALL FTOTER(F9,F9T(ISYS))
      PRINT 360, F9T(ISYS),(F9(IG),IG=1,NUMG)
  360 FORMAT(10X,'  9.  POLE + FOUNDATION COST TOTAL           ',5F14.2)
C-10. QUANTITY LAMPS PER LUMINAIRE
      READ(IDEV1,210) I10
      PRINT 370, (I10(IG),IG=1,NUMG)
```

```
  370 FORMAT(10X,'    10.  QTY LAMPS PER LUMINAIRE           ',14X,4I14)
C-11. QUANTITY LAMPS
      DO 380 IG=1,NUMG
      I11(IG) = I1(IG)*I10(IG)
  380 CONTINUE
      PRINT 390, (I11(IG),IG=1,NUMG)
  390 FORMAT(10X,'    11.  QUANTITY LAMPS                     ',14X,4I14)
C-12. LAMP COST EACH
      READ(IDEV1,250) F12
      PRINT 400, (F12(IG),IG=1,NUMG)
  400 FORMAT(10X,'    12.  LAMP COST EACH                     ',14X,4F14.2)
C-13. LAMP COST TOTAL
      DO 410 IG=1,NUMG
      FI11 = I11(IG)
      F13(IG) = FI11*F12(IG)
  410 CONTINUE
      CALL FTOTER(F13,F13T(ISYS))
      PRINT 420, F13T(ISYS),(F13(IG),IG=1,NUMG)
  420 FORMAT(10X,'    13.  LAMP COST TOTAL                    ',5F14.2)
C-14.  ELECTRICAL DISTRIBUTION
      READ(IDEV1,250) F30
      READ(IDEV1,250) F30A
      DO 430 IG=1,NUMG
      FI = I1(IG)
      F31(IG) = FI*(F30(IG)+F30A(IG)*F30(IG))
      F14(IG) = 200.*F31(IG)
  430 CONTINUE
      CALL FTOTER(F14,F14T(ISYS))
      PRINT 435, F14T(ISYS),(F14(IG),IG=1,NUMG)
  435 FORMAT(10X,'    14.  ELECTRICAL DISTRIBUTION            ',5F14.2)
C-14A. STANDBY GENERATOR COST
      DO 440 IG=1,NUMG
      F14A(IG) = 170.*F31(IG)
  440 CONTINUE
      CALL FTOTER(F14A,F14AT(ISYS))
      PRINT 445, F14AT(ISYS),(F14A(IG),IG=1,NUMG)
  445 FORMAT(10X,'    14A.  STANDBY GENERATOR COST            ',5F14.2)
C-14C. UPS COST
      DO 450 IG=1,NUMG
      FI1 = I1(IG)
      F14C(IL) = 0.
      IF(F30A(IG).GT.0.) F14C(IG) = 750.*FI1*F30(IG)
  450 CONTINUE
      CALL FTOTER(F14C,F14CT(ISYS))
      PRINT 460, F14CT(ISYS),(F14C(IG),IG=1,NUMG)
  460 FORMAT(10X,'    14C.  UPS COST                          ',5F14.2)
C-15. TOTAL INITIAL EQUIPMENT LESS LAMPS
      DO 470 IG=1,NUMG
      F15(IG) = F3(IG)+F9(IG)+F14(IG)+F14A(IG)+F14C(IG)
  470 CONTINUE
      CALL FTOTER(F15,F15T(ISYS))
      PRINT 480, (F15(IG),IG=1,NUMG)
  480 FORMAT(10X,'    15.  TOTAL INIT EQUIP LESS LAMPS     '14X,4F14.2)
C-16. TOTAL INITIAL EQUIPMENT INCLUDING LAMPS
      DO 490 IG=1,NUMG
      F16(IG) = F13(IG)+F15(IG)
  490 CONTINUE
      CALL FTOTER(F16,F16T(ISYS))
      PRINT 500, F16T(ISYS),(F16(IG),IG=1,NUMG)
  500 FORMAT(10X,'    16.  TOTAL INIT EQUIP INCL LAMPS        ',5F14.2)
C
C-II. INITIAL LABOR ESTIMATES
C
      PRINT 1190
 1190 FORMAT(//10X,'II.  INITIAL LABOR ESTIMATES'/)
C-18. POLE ERECTION + PAINTING
```

```
      READ(IDEV1,250) F18
      PRINT 1200, (F18(IG),IG=1,NUMG)
 1200 FORMAT(10X,'   18.  POLE ERECTION + PAINTING          ',14X,4F14.2)
C-19.  LUMINAIRE
      READ(IDEV1,250) F19
      PRINT 1210, (F19(IG),IG=1,NUMG)
 1210 FORMAT(10X,'   19.  LUMINAIRE LABOR                   ',14X,4F14.2)
C-20. NET LABOR, POLES + LUMINAIRES
      DO 1220 IG=1,NUMG
      F4 = I4(IG)
      F1 = I1(IG)
      F20(IG) = F4*F18(IG) + F1*F19(IG)
 1220 CONTINUE
      CALL FTOTER(F20,F20T(ISYS))
      PRINT 1230, F20T(ISYS),(F20(IG),IG=1,NUMG)
 1230 FORMAT(10X,'   20.  NET LABOR, POLES + LUMINAIRES     ',5F14.2)
C-21. ELECTRICAL DISTRIBUTION
      DO 1240 IG=1,NUMG
      F21(IG) = 150.*F31(IG)
 1240 CONTINUE
      CALL FTOTER(F21,F21T(ISYS))
      PRINT 1250, F21T(ISYS),(F21(IG),IG=1,NUMG)
 1250 FORMAT(10X,'   21.  LABOR ELECTRICAL DISTRIBUTION     ',5F14.2)
C-21A. LABOR STANDBY GENERATOR
      DO 1260 IG=1,NUMG
      F21A(IG) = 20.*F31(IG)
 1260 CONTINUE
      CALL FTOTER(F21A,F21AT(ISYS))
      PRINT 1270, F21AT(ISYS),(F21A(IG),IG=1,NUMG)
 1270 FORMAT(10X,'  21A.  LABOR STANDBY GENERATOR           ',5F14.2)
C-21B. LABOR UPS
      DO 1280 IG=1,NUMG
      FI1 = I1(IG)
      F21B(IG) = 0.
      IF(F30A(IG).GT.0.) F21B(IG) = 100.*FI1*F30(IG)
 1280 CONTINUE
      CALL FTOTER(F21B,F21BT(ISYS))
      PRINT 1290, F21BT(ISYS),(F21B(IG),IG=1,NUMG)
 1290 FORMAT(10X,'  21B.  LABOR UPS                         ',5F14.2)
C-22.  TOTAL INITIAL LABOR
      DO 1300 IG=1,NUMG
      F22(IG) = F20(IG) + F21(IG) + F21A(IG) + F21B(IG)
 1300 CONTINUE
      CALL FTOTER(F22,F22T(ISYS))
      PRINT 1310, F22T(ISYS),(F22(IG),IG=1,NUMG)
 1310 FORMAT(10X,'   22.  TOTAL INITIAL LABOR               ',5F14.2)
C-23. TOTAL INITIAL INVESTMENT
      DO 1320 IG=1,NUMG
      F23(IG) = F16(IG)+F22(IG)
 1320 CONTINUE
      CALL FTOTER(F23,F23T(ISYS))
      PRINT 1330, F23T(ISYS),(F23(IG),IG=1,NUMG)
 1330 FORMAT(10X,'   23.  TOTAL INITIAL INVESTMENT          ',5F14.2)
C
C-III. ILLUMINATION CALCUALTIONS
C
      PRINT 1790
 1790 FORMAT(//10X,'III.  ILLUMINATION CALCULATIONS'/)
C-25. SPACING OR AREA
      READ(IDEV1,250) F25
      PRINT 1800, (F25(IG),IG=1,NUMG)
 1800 FORMAT(10X,'   25.  SPACING OR AREA                   ',14X,4F14.2)
C-26. UTILIZATION FACTOR
      READ(IDEV1,250) F26
      PRINT 1810, (F26(IG),IG=1,NUMG)
 1810 FORMAT(10X,'   26.  UTILIZATION FACTOR                ',14X,4F14.2)
```

```
C-27. MAINTENANCE FACTOR
      READ(IDEV1,250) F27
      PRINT 1820, (F27(IG),IG=1,NUMG)
 1820 FORMAT(10X,'   27.  MAINTENANCE FACTOR                  ',14X,4F14.2)
C-28. DESIGN FOOTCANDLES
      READ(IDEV1,250) F28
      PRINT 1830, (F28(IG),IG=1,NUMG)
 1830 FORMAT(10X,'   28.  DESIGN FOOTCANDLES                  ',14X,4F14.2)
C-29. COST PER LINEAL FOOT OR ACRE
      DO 1840 IG=1,NUMG
      F4 = I4(IG)
      IF(F4 .EQ. 0.) F4 = I4(1)
      F29(IG) = F23(IG)/(F25(IG)*F4)
      CALL FTOTER(F29,F29T(ISYS))
 1840 CONTINUE
      PRINT 1850, F29T(ISYS),(F29(IG),IG=1,NUMG)
 1850 FORMAT(10X,'   29.  INIT COST PER LINEAL FT OR ACRE ',4F14.2)
C
C-IV. ANNUAL COSTS
C
      CALL PAGE(1)
      PRINT 2390
 2390 FORMAT(/10X,'IV.  ANNUAL COSTS',/)
C-30. KW PER LUMINAIRE
      PRINT 2400, (F30(IG),IG=1,NUMG)
 2400 FORMAT(10X,'   30.  KW PER LUMINAIRE                    ',14X,4F14.2)
C-30A. KW UPS POWER LOSS
      DO 2410 IG=1,NUMG
      F1 = I1(IG)
      F30A(IG) = F1*F30(IG)*F30A(IG)
 2410 CONTINUE
      PRINT 2420, (F30A(IG),IG=1,NUMG)
 2420 FORMAT(10X,'   30A.  KW UPS POWER LOSS                  ',14X,4F14.2)
C-31. TOTAL SYSTEM KW
      CALL FTOTER(F31,F31T(ISYS))
      PRINT 2430, F31T(ISYS),(F31(IG),IG=1,NUMG)
 2430 FORMAT(10X,'   31.  TOTAL SYSTEM KW                     ',5F14.0)
C-32. ANNUAL OPERATION
      READ(IDEV1,250) F32
      PRINT 2440, (F32(IG),IG=1,NUMG)
 2440 FORMAT(10X,'   32.  ANNUAL OPERATION (HOURS)            ',14X,4F14.0)
C-33. TOTAL ENERGY KWH/YEAR
      DO 2450 IG=1,NUMG
      F33(IG) = F31(IG)*F32(IG)
 2450 CONTINUE
      CALL FTOTER(F33,F33T(ISYS))
      PRINT 2460, F33T(ISYS),(F33(IG),IG=1,NUMG)
 2460 FORMAT(10X,'   33.  TOTAL ENERGY KWH/YEAR               ',5F14.0)
C-34. ENERGY COST PER KWH
      READ(IDEV1,250) F34
      PRINT 2470, (F34(IG),IG=1,NUMG)
 2470 FORMAT(10X,'   34.  ENERGY COST PER KWH                 ',14X,4F14.4)
C-35. DEMAND CHARGE/KW/MONTH
      READ(IDEV1,250) F35
      PRINT 2480, (F35(IG),IG=1,NUMG)
 2480 FORMAT(10X,'   35.  DEMAND CHARGE/KW/MONTH              ',14X,4F14.4)
C-36. DEMAND CHARGE PER YEAR
      DO 2490 IG=1,NUMG
      F36(IG) = F31(IG)*F35(IG)*12.
 2490 CONTINUE
      CALL FTOTER(F36,F36T(ISYS))
      PRINT 2500, F36T(ISYS),(F36(IG),IG=1,NUMG)
 2500 FORMAT(10X,'   36.  DEMAND CHARGE PER YEAR              ',5F14.2)
C-37. ANNUAL KWH COST
      DO 2510 IG=1,NUMG
      F37(IG) = F33(IG)*F34(IG)
```

```
 2510 CONTINUE
      CALL FTOTER(F37,F37T(ISYS))
      PRINT 2520, F37T(ISYS),(F37(IG),IG=1,NUMG)
 2520 FORMAT(10X,'    37.  ANNUAL KWH COST                        ',5F14.2)
C-37D. DIESEL FUEL COST
      DO 2530 IG=1,NUMG
      F37D(IG) = F31(IG)*.40*.08*50.
 2530 CONTINUE
      CALL FTOTER(F37D,F37DT(ISYS))
      PRINT 2540, F37DT(ISYS),(F37D(IG),IG=1,NUMG)
 2540 FORMAT(10X,'    37D.  DIESEL FUEL COST                      ',5F14.2)
C-38. GROUP RELAMPING PERIOD
      READ(IDEV1,250) F38
      PRINT 2550, (F38(IG),IG=1,NUMG)
 2550 FORMAT(10X,'    38.  GROUP RELAMPING PERIOD (HOURS)    ',14X,4F14.0)
C-38A. LAMP LIFE (SPOT REPLACEMENT ONLY)
      READ(IDEV1,250) F38A
      PRINT 2560, (F38A(IG),IG=1,NUMG)
 2560 FORMAT(10X,'    38A.  RATED LAMP LIFE (HOURS)           ',14X,4F14.0)
C-38B. PORTION OF LAMPS SPOT REPLACED
      READ(IDEV1,250) F38B
      PRINT 2570, (F38B(IG),IG=1,NUMG)
 2570 FORMAT(10X,'    38B.  PORTION OF LAMPS SPOT REPLACED    ',14X,4F14.2)
C-39. QUANTITY OF REPLACEMENT LAMPS
      DO 2580 IG=1,NUMG
      F11 = I11(IG)
      F39(IG)    = (F11*(1.+F38B(IG))*F32(IG)/F38(IG))
 2580 CONTINUE
      PRINT 2590, (F39(IG),IG=1,NUMG)
 2590 FORMAT(10X,'    39.  QUANTITY OF REPLACEMENT LAMPS      ',14X,4F14.0)
C-40. REPLACEMENT LAMP COST
      DO 2600 IG=1,NUMG
      F40(IG) = F39(IG) * F12(IG)
 2600 CONTINUE
      CALL FTOTER(F40,F40T(ISYS))
      PRINT 2610, F40T(ISYS),(F40(IG),IG=1,NUMG)
 2610 FORMAT(10X,'    40.  REPLACEMENT LAMP COST                  ',5F14.2)
C
C-V. ANNUAL MAINTENANCE, LABOR + MATERIALS
C
      PRINT 2615
 2615 FORMAT(//10X,'V.  ANNUAL MAINTENANCE, LABOR + MATERIALS'//)
C-43. GROUP RELAMPINGS/YEAR/LUMINAIRE
      DO 2620 IG=1,NUMG
      F43(IG) = F32(IG)/F38(IG)
 2620 CONTINUE
      PRINT 2630, (F43(IG),IG=1,NUMG)
 2630 FORMAT(10X,'    43.  GROUP RELAMPINGS/YEAR/LUMINAIRE ',14X,4F14.2)
C-43A. SPOT RELAMPINGS/YEAR/LUMINAIRE
      DO 2640 IG=1,NUMG
      F43A(IG) = F38B(IG)*F43(IG)
 2640 CONTINUE
      PRINT 2650, (F43A(IG),IG=1,NUMG)
 2650 FORMAT(10X,'    43A.  SPOT RELAMPINGS/YEAR/LUMINAIRE   ',14X,4F14.4)
C-44. RELAMPING COST-LABOR
      DO 2660 IG=1,NUMG
      F1 = I1(IG)
      F44(IG) = F1*10.*(.3*F43(IG)+.5*F43A(IG))
 2660 CONTINUE
      CALL FTOTER(F44,F44T(ISYS))
      PRINT 2670, F44T(ISYS),(F44(IG),IG=1,NUMG)
 2670 FORMAT(10X,'    44.  RELAMPING COST - LABOR                 ',5F14.2)
C-46. CLEANINGS/YEAR/LUMINAIRE
      DO 2680 IG=1,NUMG
      F46(IG) = 1.-F32(IG)/F38(IG)
      IF(F46(IG).LT.0.) F46(IG)=0.
```

```
 2680 CONTINUE
      PRINT 2690, (F46(IG),IG=1,NUMG)
 2690 FORMAT(10X,'  46.  CLEANINGS/YEAR/LUMINAIRE            ',14X,4F14.2)
C-47. CLEANING COST - LABOR
      DO 2700 IG=1,NUMG
      F1 = I1(IG)
      F47(IG) = F1*10.*.2*F46(IG)
 2700 CONTINUE
      CALL FTOTER(F47,F47T(ISYS))
      PRINT 2710, F47T(ISYS),(F47(IG),IG=1,NUMG)
 2710 FORMAT(10X,'  47.  CLEANING COST - LABOR           ',5F14.2)
C-48. PAINTING TIME PER POLE
      READ(IDEV1,250) F48
      PRINT 2720, (F48(IG),IG=1,NUMG)
 2720 FORMAT(10X,'  48.  PAINTING TIME PER POLE           ',14X,4F14.2)
C-50. PAINTING COST - LABOR
      DO 2730 IG=1,NUMG
      F4 = I4(IG)
      F50(IG) = F4*10.*F48(IG)*.2
 2730 CONTINUE
      CALL FTOTER(F50,F50T(ISYS))
      PRINT 2740, F50T(ISYS),(F50(IG),IG=1,NUMG)
 2740 FORMAT(10X,'  50.  PAINTING COST - LABOR           ',5F14.2)
C-51. REPLACEMENT PARTS, PAINT, ETC.
      DO 2750 IG=1,NUMG
      F51(IG) = .01*F15(IG)
 2750 CONTINUE
      CALL FTOTER(F51,F51T(ISYS))
      PRINT 2760, F51T(ISYS),(F51(IG),IG=1,NUMG)
 2760 FORMAT(10X,'  51.  REPLACEMENT PARTS, PAINT, ETC.  ',5F14.2)
C-52. TOTAL ANNUAL MAINTENANCE
      DO 2770 IG=1,NUMG
      F52(IG) = F44(IG)+F47(IG)+F50(IG)+F51(IG)
 2770 CONTINUE
      CALL FTOTER(F52,F52T(ISYS))
      PRINT 2780, F52T(ISYS),(F52(IG),IG=1,NUMG)
 2780 FORMAT(10X,'  52.  TOTAL ANNUAL MAINTENANCE COST   ',5F14.2)
C-53. TOTAL ANNUAL MAINTENANCE
      DO 2790 IG=1,NUMG
      F53(IG) = F36(IG)+F37(IG)+F37D(IG)+F40(IG)+F52(IG)
 2790 CONTINUE
      CALL FTOTER(F53,F53T(ISYS))
      PRINT 2800, F53T(ISYS),(F53(IG),IG=1,NUMG)
 2800 FORMAT(10X,'  53.  ANNUAL OPERATING COST           ',5F14.2)
C-54. ANNUAL OP'NG COST PER FT OR ACRE
      DO 2810 IG = 1,NUMG
      F4 = I4(IG)
      IF(F4 .EQ. 0) F4 = I4(1)
      F54(IG) = F53(IG)/(F25(IG)*F4)
 2810 CONTINUE
      CALL FTOTER(F54,F54T(ISYS))
      PRINT 2820, F54T(ISYS),(F54(IG),IG=1,NUMG)
 2820 FORMAT(10X,40H   54.  ANNUAL OP'NG COST PER FT OR ACRE,5F14.2)
C
C-VI. ANNUAL OWNERSHIP
C
      PRINT 3500
 3500 FORMAT(//10X,'VI.  ANNUAL OWNERSHIP + OPERATING COST  '/)
C-55. FIXED OWNERSHIP COST
      DO 3510 IG=1,NUMG
      F55(IG) = .142*(F15(IG)+F22(IG))
 3510 CONTINUE
      CALL FTOTER(F55,F55T(ISYS))
      PRINT 3520, F55T(ISYS),(F55(IG),IG=1,NUMG)
 3520 FORMAT(10X,'  55.  FIXED OWNERSHIP COST            ',5F14.2)
C-56. ANNUAL OWNERSHIP + OPERATING COST
```

```
            DO 3530 IG=1,NUMG
            F56(IG) = F53(IG)+F55(IG)
      3530  CONTINUE
            CALL FTOTER(F56,F56T(ISYS))
            PRINT 3540, F56T(ISYS),(F56(IG),IG=1,NUMG)
      3540  FORMAT(10X,40H    56.  ANNUAL OWNERSHIP + OP'ING COST   ,5F14.2)
C-58. TOTAL PER LINEAL FOOT OR ACRE
            DO 3550 IG = 1,NUMG
            F4 = I4(IG)
            IF(F4 .EQ. 0) F4 = I4(1)
            F58(IG) = F56(IG)/(F25(IG)*F4)
      3550  CONTINUE
            CALL FTOTER(F58,F58T(ISYS))
            PRINT 3560, F58T(ISYS),(F58(IG),IG=1,NUMG)
      3560  FORMAT(10X,'    58.  TOTAL PER LINEAL FOOT OR ACRE     ',5F14.2)
            GO TO 100
C
C-COMPARISION OF SYSTEMS
C
      4000  IS1 = 4 * ISYS -3 -4
            DO 4005 IS = IS1,ISYS
      4005  SYSCOL(I) = SPACES
            ISYS = ISYS - 1
            IS1 = -4
            K = 0
C-START OF MAIN COMPARISION LOOP
      4010  IS1 = IS1 + 5
            IS2 = IS1 + 4
            IF(IS1.GT.ISYS) GO TO 9999
            IF(IS2.GT.ISYS) IS2 = ISYS
            DO 4020 I = 1,5
            DO 4020 J = 1,4
            K = K + 1
            HEAD(I,J) = SYSCOL(K)
      4020  CONTINUE
            CALL PAGE(2)
C
C-1. INITIAL EQUIPMENT INVESTMENT
C
            PRINT 190
C-1. QUANTITY OF LUMINAIRES
            PRINT  240, (I1T(IS),IS=IS1,IS2)
C-3. LUMINAIRE COST TOTAL
            PRINT 230, (F3T(IS),IS=IS1,IS2)
C-4. QUANTITY OF POLES
            PRINT 290, (I4T(IS),IS=IS1,IS2)
C-9. POLE + FOUNDATION COST TOTAL
            PRINT 360, (F9T(IS),IS=IS1,IS2)
C-14. ELECTRICAL DISTRIBUTION
            PRINT 435, (F14T(IS),IS=IS1,IS2)
C-14A. STANDBY GENERATOR COST
            PRINT 445, (F14AT(IS),IS=IS1,IS2)
C-14C. UPS COST
            PRINT 460, (F14CT(IS),IS=IS1,IS2)
C-16. TOTAL INIT EQUIP INCL LAMPS
            PRINT 500, (F16T(IS),IS=IS1,IS2)
C-17. RELATIVE INIT EQUIP INVESTMENT
            CMIN = 9999999999.
            DO 4030 IS = 1,ISYS
            IF(CMIN .GT. F16T(IS)) CMIN = F16T(IS)
      4030  CONTINUE
            DO 4040 IS = 1,ISYS
            F17(IS) = F16T(IS)/CMIN
      4040  CONTINUE
            PRINT 4050, (F17(IS),IS=IS1,IS2)
      4050  FORMAT(10X,'   17.  RELATIVE INIT EQUIP INVESTMENT   ',5F14.2)
```

```
C
C-II. INITIAL LABOR ESTIMATES
C
      PRINT 1190
C-20. NET LABOR, POLES + LUMINAIRES
      PRINT 1230, (F20T(IS),IS=IS1,IS2)
C-21. LABOR ELECTRICAL DISTRIBUTION
      PRINT 1250, (F21T(IS), IS=IS1,IS2)
C-22. TOTAL INITIAL LABOR
      PRINT 1310, (F22T(IS),IS=IS1,IS2)
C-23. TOTAL INITIAL INVESTMENT
      PRINT 1330, (F23T(IS),IS=IS1,IS2)
C-24. RELATIVE INITIAL INVESTMENT
      CMIN = 9999999999.
      DO 4060 IS=1,ISYS
      IF(CMIN.GT.F23T(IS)) CMIN = F23T(IS)
 4060 CONTINUE
      DO 4070 IS=1,ISYS
      F24(IS) = F23T(IS)/CMIN
 4070 CONTINUE
      PRINT 4080, (F24(IS),IS=IS1,IS2)
 4080 FORMAT(10X,'   24.  RELATIVE INITIAL INVESTMENT      ',5F14.2)
C,
C-IV. ANNUAL COSTS
C
      PRINT 2390
C-31. TOTAL SYSTEM KW
      PRINT 2430, (F31T(IS),IS=IS1,IS2)
C-33. TOTAL ENERGY KWH/YEAR
      PRINT 2460, (F33T(IS),IS=IS1,IS2)
C-36.. DEMAND CHARGE PER YEAR
      PRINT 2500, (F36T(IS),IS=IS1,IS2)
C-37. ANNUAL KWH COST
      PRINT 2520, (F37T(IS),IS=IS1,IS29)
C-37D. DIESEL FUEL COST
      PRINT 2540, (F37DT(IS),IS=IS1,IS2)
C-40. REPLACEMENT COST
      PRINT 2610, (F40T(IS),IS=IS1,IS2)
C
C-V. ANNUAL MAINTENANCE, LABOR & MATERIALS
C
      PRINT 2615
C-44. RELAMPING COST - LABOR
      PRINT 2670, (F44T(IS),IS=IS1,IS2)
C-47. CLEANING COST - LABOR
      PRINT 2710, (F47T(IS),IS=IS1,IS2)
C-50. PAINTING COST - LABOR
      PRINT 2740, (F50T(IS),IS=IS1,IS2)
C-51. REPLACEMENT PARTS, PAINT, ETC.
      PRINT 2760, (F51T(IS),IS=IS1,IS2)
C-52. TOTAL ANNUAL MAINTENANCE COST
      PRINT 2780, (F52T(IS),IS=IS1,IS2)
C-53. ANNUAL OPERATING COST
      PRINT 2800, (F53T(IS),IS=IS1,IS2)
C
C-VI. ANNUAL OWNERSHIP + OPERATING COST
C
      PRINT 3500
C-55. FIXED OWNERSHIP COST
      PRINT 3520, (F55T(IS),IS=IS1,IS2)
C-56. ANNUAL OWNERSHIP + OP'ING COST
      PRINT 3540, (F56T(IS),IS=IS1,IS2)
C
C-VII. RELATIVE COSTS OF LIGHT
C
      PRINT 4100
```

```
 4100 FORMAT(//10X,'VII.  RELATIVE COSTS OF LIGHT          '/)
C-59. RELATIVE COSTS EXCLUDING FIXED
      CMIN = 999999999.
      DO 4110 IS = 1,ISYS
      F59C(IS) = F56T(IS) - F55T(IS)
      IF(F59C(IS) .LT. CMIN) CMIN = F59C(IS)
 4110 CONTINUE
      DO 4120 IS = 1,ISYS
      F59(IS) = F59C(IS)/CMIN
 4120 CONTINUE
      PRINT 4130, (F59(IS),IS=IS1,IS2)
 4130 FORMAT(10X,'    59.  RELATIVE COST EXCLUDING FIXED    ',5F14.2)
C-60. RELATIVE TOTAL COST
      CMIN = 9999999999.
      DO 4140 IS = 1, ISYS
      IF(F56T(IS) .LT. CMIN) CMIN = F56T(IS)
 4140 CONTINUE
      DO 4150 IS = 1,ISYS
      F60(IS) = F56T(IS)/CMIN
 4150 CONTINUE
      PRINT 4160, (F60(IS),IS=IS1,IS2)
 4160 FORMAT(10X,'    60.  RELATIVE TOTAL COST              ',5F14.2)
      GO TO 4010
 9999 CONTINUE
      ITOP = 7656B
      NULL = 7600B
      PRINT 9998, ITOP
 9998 FORMAT(10R2)
      REWIND IDEV1
      STOP
      END
C-THIS SUBROUTINE FINDS THE TOTAL OF AN INTEGER ARRAY OF 6 ELEMENTS
      SUBROUTINE ITOTER(I,ITOTAL)
      DIMENSION I(6)
      ITOTAL = I(1)+I(2)+I(3)+I(4)+I(5)+I(6)
      RETURN
      END
C-THIS SUBROUTINE FINDS THE TOTAL OF A REAL ARRAY OF 6 ELEMENTS
      SUBROUTINE FTOTER(F,TOTAL)
      DIMENSION F(6)
      TOTAL = F(1)+F(2)+F(3)+F(4)+F(5)+F(6)
      RETURN
      END
C-THIS SUBROUTINE CHANGES PAGES AND PRINTS THE HEADING
      SUBROUTINE PAGE(IFLAG)
      COMMON /HED/ HEAD(5,4),SYSCOL(130),DESCRI(5,120),ISYS
      COMMON /DEV/ IDEV1
      DATA IPAGE/0/
      IPAGE = IPAGE + 1
      ITOP = 7656B
      NULL =7600B
      PRINT 90,ITOP
   90 FORMAT(10R2)
      PRINT 100, IPAGE
  100 FORMAT(1H1,40X,'U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT',
     1 27X,'PAGE',I4)
      PRINT 110
  110 FORMAT(/53X,'ECONOMIC COMPARISION')
C-PRINT COLUMN HEADING FOR SIDE BY SIDE, AND DESCRIPTION
      IF(IFLAG .GT. 1) GO TO 240
      PRINT 210
  210 FORMAT(1H )
      J = (ISYS - 1) * 4
      DO 230 K = 1,4
      J = J + 1
      PRINT 220, SYSCOL(J),(DESCRI(I,J),I=1,5)
```

```
  220 FORMAT(10X,A10,10X,5A10)
  230 CONTINUE
  240 CONTINUE
C-PRINT COLUMN HEADINGS FOR COMPONENT GROUPS
      PRINT 120, (HEAD(IG,1),IG=1,5)
  120 FORMAT(/50X,5(4X,A10))
      PRINT 130, (HEAD(IG,2),IG=1,5)
  130 FORMAT(50X,5(4X,A10))
      PRINT 140, (HEAD(IG,3),IG=1,5)
  140 FORMAT(50X,5(4X,A10))
      PRINT 150, (HEAD(IG,4),IG=1,5)
  150 FORMAT(50X,5(4X,A10))
      RETURN
      END
C-SUBROUTINE FOR ZEROING ARRAYS
      SUBROUTINE ZERO
      COMMON /EQP/ FEQP(84),IEQP(24)
      COMMON /LAB/ FLAB(42)
      COMMON /ILL/ FILL(42)
      COMMON /CST/ FCST(90)
      COMMON /MNT/ FMNT(72)
      COMMON /ANN/ FANN(30)
      DO 110 I=1,84
  110 FEQP(I) = 0.
      DO 120 I=1,24
  120 IEQP(I) = 0
      DO 130 I=1,42
  130 FLAB(I) = 0.
      DO 140 I=1,42
  140 FILL(I) = 0.
      DO 150 I=1,90
  150 FCST(I) = 0.
      DO 160 I=1,72
  160 FMNT(I) = 0.
      DO 170 I=1,30
  170 FANN(I) = 30   6.
      RETURN
      END
/
```

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS STRATEGIC AIR COMMAND
OFFUTT AIR FORCE BASE, NEBRASKA, 68113

REPLY TO ATTN OF: DOWA (Maj Newcomb, 2681) 26 August 1975

SUBJECT: Illumination Data for Giant Lock

TO: DEEA

1. Reference: Conference between Major Newcomb-DOWA and Mr. Gano-DEEA on 8 August 1975.

2. The mean daily and annual required lighting times for 28 bases is contained in attachment 1.

3. The lighting time was computed for a threshold illumination value of 2 footcandles (fc). The illumination on a flat surface is 42 fc when the upper limb of the sun appears (or disappears) at the horizon. The morning and evening civil twilight periods (sun below horizon .8-6°) were considered in order to obtain the required lighting time for an illumination threshold value of 2 fc.

4. Little is known about the relationship between cloud conditions and illumination during the twilight period. The daylight assumption that the average illumination on a flat surface is reduced 50% by "average" cloud conditions was used. This assumption required a sun depression angle of 3.5° below the horizon in order to reduce the illumination on a flat surface to 2 fc. (A "clear sky" assumption would have required a depression angle of 4° which decreases the required lighting time by 4 minutes.)

5. The approximate required lighting time for the threshold illumination values of 1 and 5 fc can be obtained from the values in attachment 1 as follows:

a. For 1 fc; subtract 4 minutes from the mean daily required lighting time.

DATA ON NIGHT-LIGHTING: MEAN [illegible] ANN[illegible] HOURS

Peace . . . . is our Profession

ATTACHMENT 16 16-1

b. For 5 fc; add 10 minutes to the mean daily required lighting time.

Dean D. Bartlett

DEAN D. BARTLETT, Lt Col, USAF
Chief, Plans Division
Directorate of Weather
Deputy Chief of Staff, Operations

1 Atch
Required Lighting
Times for 28 Bases

'6-2

FIGURE UNDERLINED hours and minutes per year LIGHT is Required.
FIGURE CIRCLED is hours and minutes per day LIGHTING is Required.

34 - 121.5

←,6 ,16 →

BEALE	Civil Twilight	Ill = 2.5 fc	Sunrise	Sunset	Ill = 2.5 fc	Civil Twilight	Time Light [illegible]	Sec
DEC	0652	0704	0721	1646	1705	1717	839	
JUN	0408	0421	0440	1935	1954	2007	507	
ANN			4015+	200-45=	4215'45"		673	11'13"
46.5-84.5 Kincheloe [illegible]								
DEC	0745	0759	0819	1654	1720	1738	879	
JUN	0405	0421	0444	2035	2059	2115	442	
ANN			4015+	6-05=	4021'05"		660.5	11'01"
48-101 [illegible]								
DEC	0752	0809	0834	1653	1721	1739	888	
JUN	0402	0419	0444	2057	2114	2130	425	
ANN			3650+	340-40=	3990'40"		656.5	10'56"
[illegible]								
DEC	0659	0714	0736	1601	1623	1637	877	
JUN	0311	0327	0352	1952	2016	2032	431	
ANN			3650+	328-30=	3978'30"		654	10'54"
47-68 L-[illegible]								
DEC	0640	0654	0714	1545	1607	1621	889	
JUN	0300	0314	0336	1930	1955	2011	439	
ANN			4015+	24-20=	4039'20"		664	11'04"

MAC FORM 36c JAN 66 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE GENERAL PURPOSE WORK SHEET

16

	← 16				16 →			
ANDERSON	CIVIL TWILIGHT	ILL = 2 FC [illegible]	SUNRISE	SUNSET	ILL = 2 FC [illegible]	CIVIL TWILIGHT	TIME LIGHTING REQ	
JAN	0625	0634	0648	1815	1829	1838	725	
FEB	0620	0628	0641	1827	1840	1849	708	
MAR	0603	0612	0625	1831	1844	1853	688	
[illegible]	0543	0551	0604	1834	1847	1856	664	
MAY	0520	0539	0553	1841	1854	1904	645	
[illegible]	0530	0540	0554	1850	1903	1913	637	
[illegible]	0539	0548	0602	1851	1905	1914	643	
[illegible]	0546	0555	0608	1839	1852	1901	663	
[illegible]	0548	0556	0609	1818	1831	1839	685	
[illegible]	0550	0559	0612	1758	1811	1820	709	
[illegible]	0600	0609	0622	1750	1803	1812	726	
[illegible]	0615	0614	0638	1758	1812	1821	727	
[illegible]			4015+	146-00 =	4161'00"		654.5	11'24"
30.5 121.5								
[illegible]								
[illegible]	0648	0700	0717	1651	1702	1709	238	
[illegible]	0414	0426	0445	1930	1949	2002	517	
[illegible]			4015+	103-25 =	4118'25"		677.5	11'17"

16

MAC FORM JAN [illegible] 36c PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE GENERAL PURPOSE WORK SHEET

3U - 98.5

SHEPPARD	CIVIL TWILIGHT	ILL = [illegible]	SUNRISE	SUNSET	ILL = [illegible]	CIVIL TWILIGHT	TIME LIGHTING [illegible]
DEC	0708	0719	0735	1726	1744	1757	815
JUN	0454	0506	0523	1958	2010	2018	536
[illegible]			4015 + 91-15 =	4106' 15"			675.5 11' 15"
40.5-33.5 [illegible]							
[illegible]	0726	0742	0807	1657	1713	1723	869
[illegible]	0413	0427	0449	2021	2044	2059	463
[illegible]			4015 + 36-30 =	4051' 30"			666 11' 06"
36 - [illegible]							
[illegible]	0638	0650	0707	1649	1707	1719	823
[illegible]	0413	0425	0443	1920	1944	2000	521
[illegible]			4015 + 73 =	4088' 00"			672 11' 12"
[illegible]							
[illegible]	0644	0656	0713	1648	1705	1717	831
[illegible]	0411	0423	0442	1926	1945	1957	518
[illegible]			4015 + 85-10 =	4100' 10"			674.5 11' 14"
33.5-3[illegible]							
[illegible]	0627	0638	0654	1649	1706	1718	812
[illegible]	0415	0427	0444	1907	1926	1939	541
[illegible]			4015 + 103-25 =	4118' 25"			676.5 11' 17"

MAC FORM JAN [illegible] 36c PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE GENERAL PURPOSE WORK SHEET

6-9

← .6 .6 →

MARCH	CIVIL TWILIGHT	ILL = 2 FT CD	SUNRISE	SUNSET	ILL = 2 FT CD.	CIVIL TWILIGHT	TIME LIGHTING REQ.
DEC	0622	0633	0650	1644	1701	1712	812
JUN	0409	0421	0438	1903	1920	1932	541
ANN			4015 + 97-20 =	4112'20"			676.5 11'16"
PE[illegible] 43-71							
DE[illegible]	0640	0653	0712	1611	1631	1645	862
[illegible]	0328	0342	0404	1926	1949	2002	473
[illegible]			4015 + 42-35 =	4057'35"			667.5 11'07"
[illegible] 73.5 PCH							
DEC	0654	0708	0728	1617	1637	1651	871
JUN	0332	0347	0409	1943	2005	2020	462
[illegible]			4015 + 36-30 =	4051'30"			666.5 11'06"
[illegible] 3-43							
[illegible]	0704	0714	0729	1656	1713	1725	841
[illegible]	0416	0430	0450	1942	1956	2015	514
[illegible]			4015 + 103-25 =	4118'25"			677.5 11'17"
[illegible] 44-103							
[illegible]	0652	0705	0725	1616	1636	1650	869
[illegible]	0333	0447	0409	1940	2001	2015	526
[illegible]			4015 + 225-5 =	4240'05"			697.5 11'37"

MAC FORM 36c JAN 66 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE GENERAL PURPOSE WORK SHEET

GRAND FORKS

← .6 .6 →

MONTH	CIVIL TWILIGHT	ILL = 2 FT CD	SUNRISE	SUNSET	ILL = 2 ft cd	CIVIL TWILIGHT	TIME LIGHTING REQ.
JAN	736	750	810	512	533	547	14 17
FEB	655	708	726	601	619	633	12 49
MAR	600	613	631	643	701	714	11 12
APR	456	509	529	728	748	862	9 21
MAY	406	421	444	809	832	847	7 49
JUN	348	405	430	833	858	914	7 07
JULY	413	429	452	819	841	858	7 48
AUG	459	512	532	732	752	806	9 20
SEP	543	555	614	630	649	701	11 06
OCT	626	638	657	530	549	602	12 36
NOV	710	724	744	446	506	521	14 03
DEC	740	0755	817	439	0501	515	14:54
ANN	—	—	—	—	—	—	11:01
			4015+	6-5 =	4021'05"		

MAC FORM JAN 68 36c PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE GENERAL PURPOSE WORK SHEET

16-7

32.5 - 93 [illegible]

BASE [illegible]	CIVIL TWILIGHT	ILL = 2 ft cd	SUN RISE	SUNSET	ILL = 2 ft cd	CIVIL TWILIGHT	TIME LIGHTING [illegible]
DEC	0646	0656	0712	1713	1733	1746	803
JUN	0440	0451	0508	1925	1943	1955	548
[illegible]			4015 + 91.15 =		4106' 15"		675.5 11' 15"
33 - 97.5 [illegible]							
[illegible]	0702	0712	0728	1727	1745	1757	807
[illegible]	0506	0512	0522	1941	1959	2011	553
[illegible]			4015 + 121-40 =		4136' 40"		680 11' 20"
47.5 - 111 [illegible]							
[illegible]	0734	0748	0810	1636	1657	1711	891
[illegible]	0345	0402	0427	2026	2046	2107	436
[illegible]			4015 + 18-15 =		4033' 15"		663.5 11' 03"
41 - [illegible]							
[illegible]	0657	0703	0722	1634	1653	1706	850
[illegible]	0354	0407	0427	1936	1956	2010	691
[illegible]			4015 + 60-50 =		4075' 50"		670.5 11' 1[illegible]"
[illegible]							
[illegible]	0700	0713	0722	1632	1651	1705	862
[illegible]	0349	0403	0425	1947	2008	2023	475
[illegible]			4015 + 48.40 =		4063' 40"		665.5 [illegible]' 08"

MAC FORM JAN 66 36c PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE GENERAL PURPOSE WORK SHEET

32.5-100

DYESS	Civil Twilight	[illegible]	[illegible]	[illegible]	[illegible]	Civil Twilight	Time [illegible]
DEC	0711	0721	0737	1738	1755	1806	806
JUN	0506	0515	0532	1949	2007	2019	548
[illegible]			4015 + 103 - 25 =		4118' 25"		677 11' 7"
405-87.5 [illegible]							
DE[illegible]	0657	0710	0730	1605	1627	1641	883
[illegible]	0320	0335	0357	1946	2010	2026	445
[illegible]			4015 + 24 - 20 =		4039' 20"		664 11' 04"
28-32.5 [illegible]							
[illegible]	0651	0700	0717	1739	1755	1805	785
[illegible]	0508	0518	0534	1929	1945	1956	573
[illegible]			4015 + 115 - 35 =		4130' 35"		679 11' 19"
[illegible]							
[illegible]	0705	0716	0732	1733	1749	1800	807
J[illegible]	0459	0510	0527	1945	2002	2014	548
[illegible]			4015 + 103 - 25 =		4118' 25"		677.5 11' 17"
S[illegible]							
D[illegible]	0648	0700	0717	1703	1720	1731	820
J[illegible]	0427	0439	0457	1930	1948	2000	531
[illegible]			4015 + 91 - 15 =		4106' 15"		675.5 11' 15"

MAC FORM JAN 68 36c PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE GENERAL PURPOSE WORK SHEET

16-9

SODIUM LAMPS

To avoid local accumulation of sodium, which is found partly in a liquid condition when these lamps are in operation, and which may cause damage to the lamp, it must be mounted within the limits of the operating position as indicated in the figure.

Warning: Sodium lamps are perfectly safe when handled with care, but contain a small quantity of sodium, a substance which developes heat when in contact with moisture.
Therefore the following precautions should be taken:

a. The lamp must be stored and shipped enclosed in its original packing.

b. Care should be taken to dispose of discarded lamps, in such a manner as to obviate the risk of fire. One such way is as follows: the lamps (not more than twenty at one time), should first be broken into small pieces in a dry atmosphere, and placed in a dry bucket of ample capacity. The container should then be taken into the open air, and half filled with water by means of a rubber hose, the operator standing at a safe distance.
After a few minutes, the sodium will be rendered harmless.

CAUTION NOTICE PACKED WITH PHILIPS LPS LAMPS

G.E.C. Sodium lamps

TYPE SOI/H (Integral)
SLI/H (Linear)
SOX (SUPERSOX)

Allow the lamp to cool before removing.

Use on A.C. only in circuit with control gear complying with the appropriate I.E.C. specification.

Sodium lamps are perfectly safe when handled with reasonable care but they contain a small quantity of metallic sodium, a substance which develops heat in contact with moisture, and therefore the following precautions must be taken.

Packing, Shipping and Storing. Sodium lamps must be packed shipped and stored completely enclosed in the wrapping provided.

They must not be sent by Post.

Disposal of burnt-out Lamps. When lamps are discarded care should be taken to obviate the risk of fire. The Lamps (of which not more than 20 should be dealt with at one time) should first be broken into small pieces in a dry atmosphere and transferred to a dry bucket or other container of ample capacity. The container should then be taken into the open air and half filled with water by means of a hose. The operator should stand at a safe distance during the process. After a few minutes the metallic sodium contained in the lamps will be rendered harmless and these may then be disposed of in the ordinary way.

XL 320

CAUTION NOTICE PACKED WITH G.E.C. LPS LAMPS

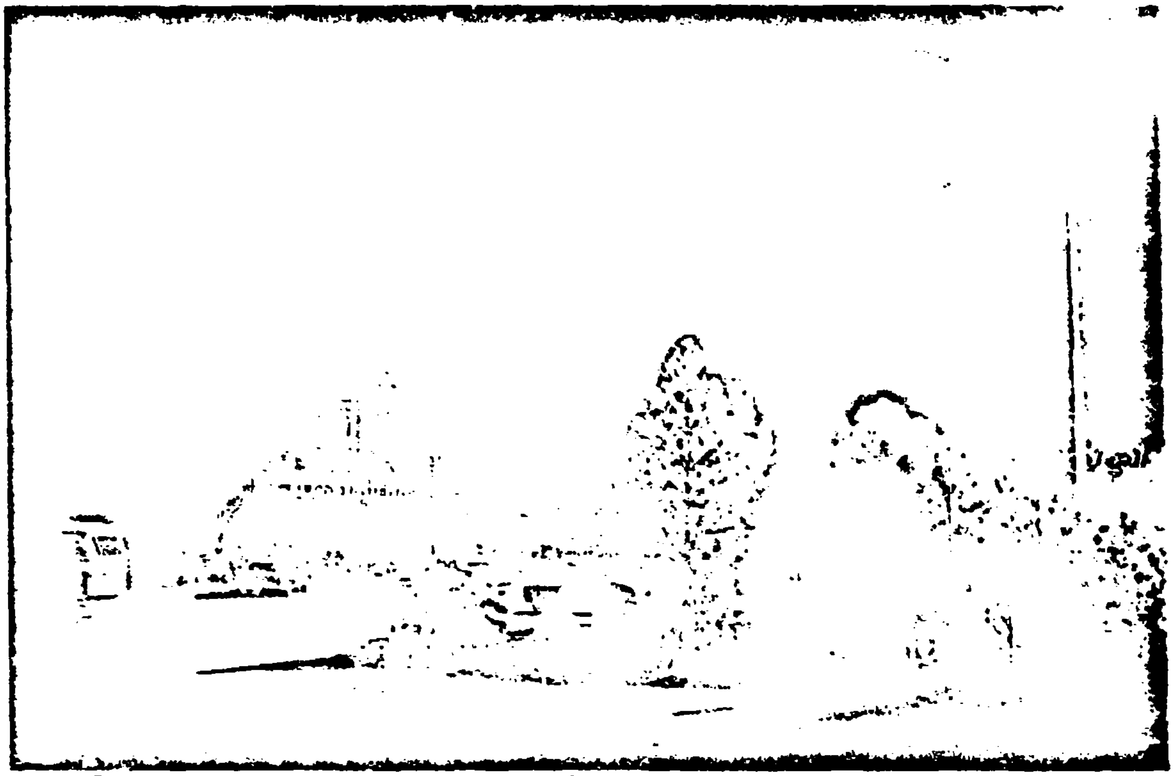
DISPOSAL INSTRUCTIONS FOR L.P.S. LAMPS

ATTACHMENT 17

AMERICAN DAYLIGHT CO.
INTERNATIONAL

Long-Arc Xenon

Wide Area Lighting



Entry and parking lot illumination at Moqui Lodge, Grand Canyon, Arizona, serves guests well, yet does not violate the rustic environment.

HIGH LUMEN OUTPUT

FEWER UNITS

BETTER DISTRIBUTION

INSTANT START, RESTART

LONG LIFE, DAYLIGHT QUALITY

SAFE, EASY TO SERVICE

ATTACHMENT 18
p 18-1

Long-Arc Xenon

ENGINEERED WIDE-AREA LIGHTING

As with any engineering problem, wide-area lighting is best achieved by providing the fewest fixtures and the lowest installation and maintenance costs necessary to do the job well. American Daylight's long-arc xenon meets these design criteria:

Fewer Units and Poles

Long-arc xenon luminaires have a visual horizontal beam spread of 150°. This very broad beam spread, matched with 20,000 watts of lighting power, provides an even coverage of an area with far fewer poles than any conventional lighting system. This results in savings in installation, equipment and maintenance costs. Architectural design is also enhanced.

Natural Daylight Quality

Xenon discharge lamps are the only available source that can be used for large area lighting that will faithfully reproduce the spectral distribution of natural daylight. This color quality provides excellent visual acuity, especially important where movement and distance must be judged, as in sports and activities involving machinery. If an object or area is distorted by predominantly yellow, blue or green light sources, then usually more light is required for identification. The use of xenon equipment reflects the colors to which the eye is most accustomed—in daylight.

High Maintained Lamp and Fixture Efficiency.

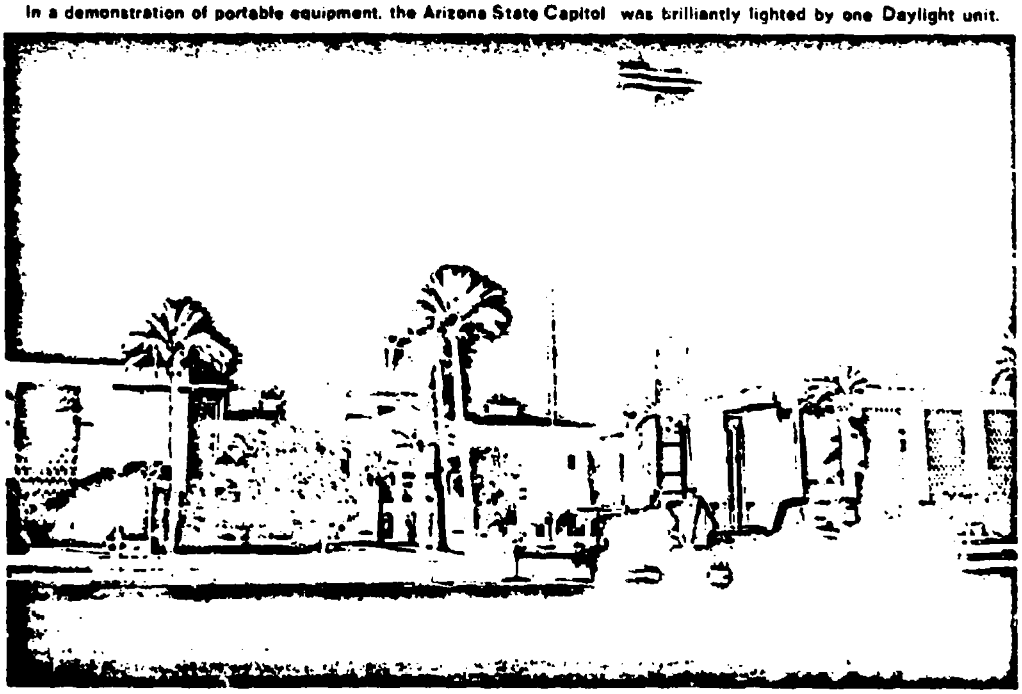
The use of long linear lamps positioned correctly within a parabola reflector provides very high fixture efficiency—over 70%. Many conventional luminaires have efficiencies of less than 50%. The xenon lamp maintains light output at 90% or better throughout the entire life of the lamp. Many discharge lamps will lose their output by as much as 60% at near end of life.

Reliable Quality

The American Daylight Company has over 12 years of experience and expertise in the manufacture of their lighting products. Their continued efforts in quality control, manufacture, and equipment performance has gained them confidence and respect.

The American Daylight long-arc xenon lighting equipment is the only equipment that can meet the total design requirements above.

In a demonstration of portable equipment, the Arizona State Capitol was brilliantly lighted by one Daylight unit.



ATTACH
18-2

provides daylight

GENERAL INFORMATION

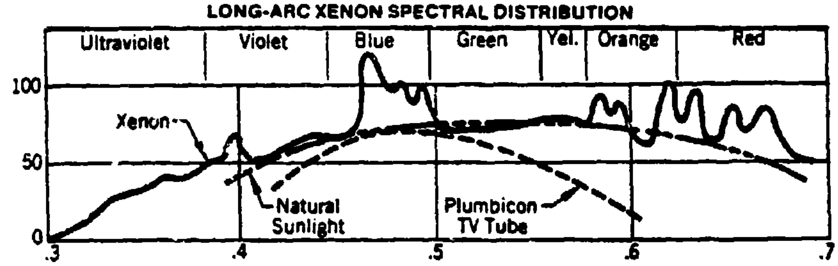
The long-arc lamps are filled with xenon, an inert gas, in a special ultra-violet absorbing quartz envelope and at a pressure of less than one atmosphere. (An important safety factor when handling them.)

Lamps are ignited instantly by a starter circuit which then drops off the line and the lamp continues to operate without aid of ballast and at unity power factor. Because there is no ballast, the lamp will ignite and operate in sub-freezing or tropical temperatures without additional starting or operating aids.

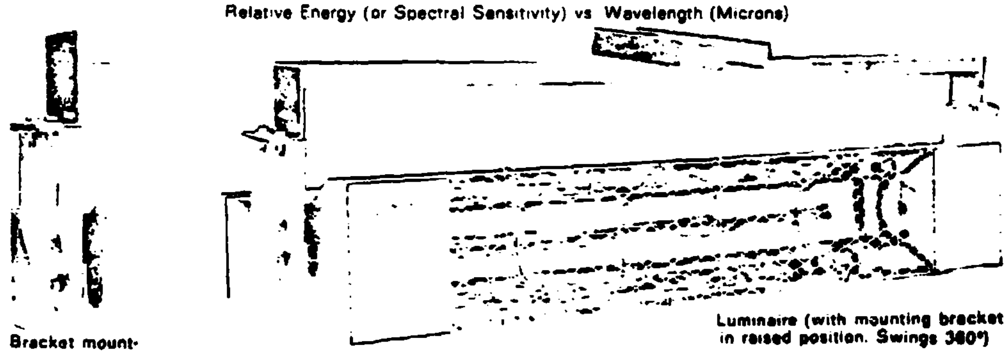
Instant re-strike (optional) capability becomes important in those applications where a momentary power interruption could cause panic, collisions of moving equipment, or delay of sporting events due to the time required by conventional discharge lamps to restrike.

Xenon lamps, with the spectral distribution very similar to natural daylight (6,500° Kelvin), is ideal for pick-up by the Plumbicon TV tube, and therefore offers the most desirable artificial lighting source for color film and TV camera pickup.

LONG-ARC XENON SPECTRAL DISTRIBUTION



Relative Energy (or Spectral Sensitivity) vs Wavelength (Microns)



Bracket mounting detail.

Luminaire (with mounting bracket in raised position. Swings 360°)

MOUNTING BRACKETS MB-M (4" OD metal pole, clamp type)
MB-W (8" to 12" OD wood pole, clamp type with through-the-pole bolts)

LUMINAIRE SPECIFICATIONS

	Luminaire Model Numbers				
	ADC-16/208	ADC-20/220	ADC-20/240	ADC-20/265	ADC-20/277
Voltage	208	220	240	265	277
Power — Watts (100% PF)	16 000	20 000	20 000	20 000	20.000
Initial Lamp Lumens	400 000	500.000	500.000	500 000	500.000
Horiz & Vert Beam Spread Medium	N/A	150° x 30°	150° x 30°	150° x 30°	150° x 30°
Wide	150° x 50°	150° x 50°	150° x 50°	150° x 50°	150° x 50°
Weight	190 lbs	200 lbs	200 lbs	200 lbs	200 lbs
Weight with bracket	195 lbs	265 lbs	265 lbs	265 lbs	265 lbs
Overall length	72"	84½"	84½"	84½"	84½"
Overall depth	19½"	19½"	19½"	19½"	19½"
Overall height	13½"	13½"	13½"	13½"	13½"

ATTACH 18-3

quality light..!

LAMP SPECIFICATIONS

	Lamp Model Numbers				
	L-16/208	L-20/220	L-20/240	L-20/265	L-20/277
Power (Watts)	16.000	20 000	20.000	20.000	20.000
Voltage	208	220	240	265	277
Current (Amps)	77	90 9	83 3	75 5	72 5
Initial Lamp Lumens	400.000	500.000	500.000	500.000	500.000
Light Color Temp (Kelvin)	6.500°	6.500°	6.500°	6 500°	6.500°
Lamp Ignition	Instant	Instant	Instant	Instant	Instant
Restrike Ignition*	Instant	Instant	Instant	Instant	Instant
Overall Length	60"	74"	74"	74"	74"
Diameter of Lamp Envelope	1-3/8"	1-3/8"	1-3/8"	1-3/8"	1-3/8"

*Optional

Lamp is warranted for 12 months, prorated monthly. Expected lamp life in excess of 10.000 hours.

COMPARATIVE CHARACTERSTICS OF FLOODLIGHTING EQUIPMENT

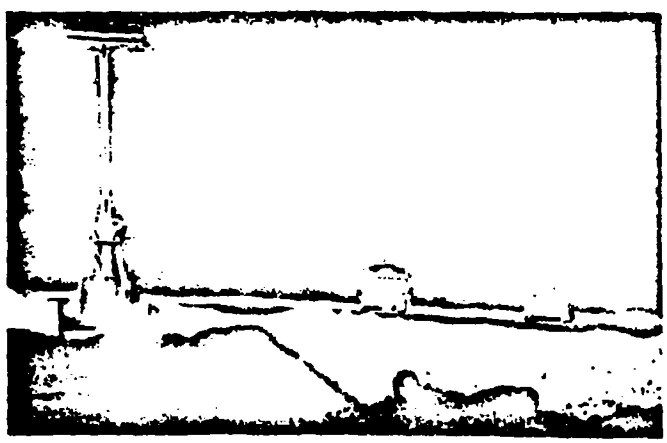
Flood Light Type	Mfr's Model	Power Req'd[1]	Start-up Time	Re-strike Time	Maintained Fixture Efficiency (MFE)[2]	Maintained Lumens Per Watt (MLPW)[3]	Units req'd to equal 20.000 W of Long-arc Xenon	Color Quality
1500-W Tungsten Halogen	Westinghouse WOF-1500	1500 W	Instant	Instant	9.809 Lumens	6 5	30 0	Good
1000-W Phosphor Mercury	Wide-Lite F-1001-D	1100 W	5-7 Min	8-12 min	17 511 Lumens	15 9	17 0	Fair to Good
1000-W Metal-Halide	GE "Power Spot	1100 W 1100 W	3-5 min	10-15 min.	25.272 Lumens	23 0	12.0	Varies — usually good
16 000-W Long-Arc Xenon	Daylight ADC-16	16.000 W	Instant	Instant (Optional)	240.312 Lumens	15 0	1 25	Excellent
20 000-W Long-Arc Xenon	Daylight ADC-20	20.000	Instant	Instant (Optional)	300.390 Lumens	15 0	1	Excellent

[1]PR = Power input (to ballast if applicable)

[2]MFE = (Lamp lumen output at 60% rated life) x (fixture efficiency) x (maintenance factor)

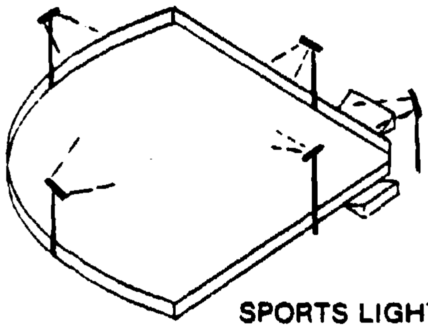
[3]$MLPW = \frac{MFE}{PR}$

Optional features: Bullet proof units • Front glass cover • Explosion-proof units
Specifications subject to change without notice



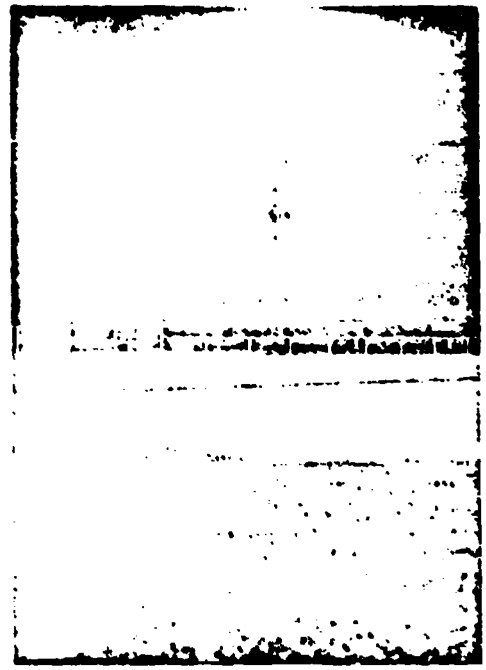
One American Daylight unit at "C" Dump, Duval Mine, Sahuarita, Arizona, eliminated need for eight previous lights and two flagmen.

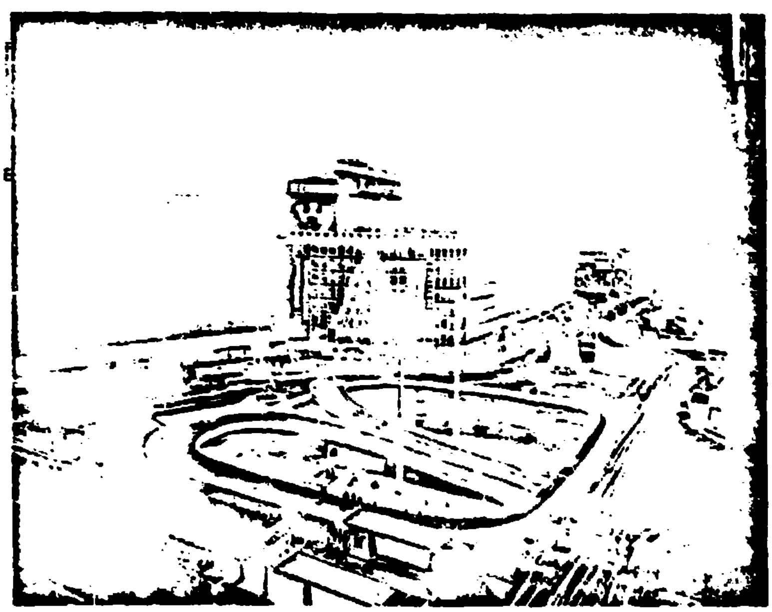
ATTACH.
18-4



SPORTS LIGHTING

Baseball, football, tennis and other sports are excellent applications for Daylight Xenon equipment. The strong vertical beam spread allows the players and spectators to "follow" the ball at all times instead of its disappearing and reappearing, as with most conventional lighting systems. In Plant City, Florida, 30 footcandles on the infield and 15 footcandles on the outfield were achieved by using only five poles instead of the conventional eight poles. This represented a great saving in installation and maintenance cost. The superior color quality of the xenon source causes players and uniforms to appear more natural, and enhances judgment of distances, speed, etc. Light quality and uninterrupted service are special advantages for television coverage of sporting events, and often may be an inducement to such coverage.

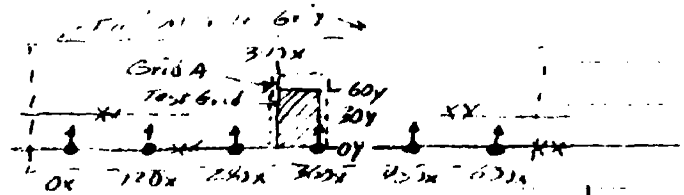




Japanese cities are noted for their exciting night life. Long-arc xenon, widely used there, gives night shoppers and motorists the confidence and safety of brilliant, daylight quality light.

ATTACH.
18-5

PERIMETER LIGHTING - DOUBLE FENCE



00100			1	1					
00110		T74A	PER LTG--DF(6-20LF) 17400005 SP120			M035 -- (020678)			
00120		V40054 4HF1	0.25	0.00	1.00				
00130		9999999999							
00140		V40054HHF1	0.00	0.00	35.00	90.00	0.00		
00160		V40054HHF1	120.00	0.00	35.00	90.00	0.00		
00180		V40054 4HF1	240.00	0.00	35.00	90.00	0.00		
00200		V40054HHF1	360.00	0.06	35.00	90.00	0.00		
00210		V40054HHF1	480.00	0.00	35.00	90.00	0.00		
00220		V40054HHF1	600.00	0.00	35.00	90.00	0.00		
00230		9999999999							
00240	1	-120.00	-30.00	0.50	120.00	120.00	0.50		FMG - HFC
00250		15	11	H	0.00	0.00	0.00	0.00	
00260	2	-120.00	-30.00	3.00	120.00	120.00	3.00		FMG - VFC 270°
00270		15	11	V	270.00	0.00	0.00	0.00	
00280	3	-120.00	-30.00	3.00	120.00	120.00	3.00		FMG - VFC 90°
00290		15	11	V	180.00	0.00	0.00	0.00	
00300	4	280.00	-25.00	0.50	370.00	110.00	0.50		GA - HFC
00310		10	24	H	0.00	0.00	0.00	0.00	
00320	5	300.00	0.00	0.50	360.00	30.00	0.50		30' TG - HFC
00330		7	7	H	0.00	0.00	0.00	0.00	
00340	6	300.00	0.00	0.50	360.00	60.00	0.50		60' TG HFC
00350		7	13	H	0.00	0.00	0.00	0.00	
00360	7	300.00	0.00	-5.50	360.00	60.00	-5.50		60' TG HFC (equiv to 41' MH)
00370		7	13	H	0.00	0.00	0.00	0.00	
00380	8	280.00	60.00	0.00	370.00	60.00	130.00		Vertical Grid @ y = 60' HFC
00390		10	14	H	0.00	370.00	60.00	0.00	
00400	9	300.00	-30.00	0.00	300.00	140.00	130.00		Vertical Grid @ x = 300' HFC
00410		18	14	H	0.00	300.00	140.00	0.00	
00420		9999999999							

ATTACHMENT 19

```
T74A     PER LTG--OF(6-POLE) 1X400HPS SP120  MH35 .  (020678                    78/02/06  09.18.01  PAGE

TSW1 =  1   1=PRINT CANDLEPOWER TABLES
TSW2 =  1   1=DISK DIRECTORY PRINT
TSW3 =  0   1=PRINT EACH POINT AFTER CALCULATION
TSW4 =  0   1=PRINT + ZERO GRID AFTER EACH LIGHT
TSW5 =  0   1=PRINT ALL CANDLEPOWER TABLES
TSW6 =  0   1=USE TS PAGE CHANGES

TDEV1 =  1   CANDLEPOWER TABLES
TDEV2 = 99   DESIGN INPUT
TDEV3 =  0
TDEV4 =  0
TDEV5 =  0
TDEV6 =  0
```

19-2

List of luminaires having candlepower data in storage

NO.	LUMID	NO.	LUMID	NO.	LUMID	NO.	LUMID
1	H150C65GF2	2	H500C65GF2	3	V250S3MAE1	4	V180L4SAE1
5	V180L4MAF2	6	H150C65LA1	7	H150C65H01	8	V35WL4MH01
9	V55WL4SN01	10	H100S76CH1	11	V150S4LLA1	12	H150C65GE3.
13	H50LS65N01	14	H150L76N01	15	H100S76H01	16	H100S76CH2
17	H400S64CH1	18	V100S76CH1	19	H20WX76A01	20	H300065GE1
21	H400S76SY1	22	H250S76FF1	23	H150C66GE1	24	H400S76WE1
25	H300S56WGF	26	H400S55N01	27	H250S75WE1	28	H400S22H01
29	H250S76GF1	30	V400S25GF1	31	V100S5MGE1	32	H100S65H01
33	V250S3MGF2	34	V250S4WF1	35	V250S3MWE1	36	V400S4MWF1
37	V400S3MGF1	38	V150S3MGF1	39	H150C64LA1	40	H150C62GF1
41	H150C64GF1	42	H150C65GE1	43	H150C62SE2	44	H400S76CH1
45	H400S76GF1	46	H400S44FF1	47	H400S55WE1	48	H400S52SF1
49	H400S65SF1	50	H135L75SF1	51	H90LS75GF1	52	H180L75SE1
53	H250S65WF1	54	H100S76WI1	55	V180LGWVL1	56	V400S4LAE1
57	H400S67CH1	58	H250S66H01	59	V100S65H01	60	V250S4LAE1
61	H400S65WF1	62	H150C65GF4	63	V250S3MGE1	64	V180L4S001
65	V180L4ML01	66	H500S65LA1				

INPUT DATA - DEPRECIATION FACTORS

LUMID	DLAMP	DDIRT	OTHFC
V400S4MWF1	.9500	.1000	1.0000

LUMINAIRE POSITION AND AIMING DATA

UNIT NO	LUMINAIRE IDCODE	X-COORD	Y-COORD	Z-COORD	HORZ ANGLE	VERT ANGLE
1	OPS	0.00	0.00	35.00	90.00	0.00
2	OPS	120.00	0.00	35.00	90.00	0.00
3	OPS	240.00	0.00	35.00	90.00	0.00
4	OPS	360.00	0.00	35.00	90.00	0.00
5	OPS	480.00	0.00	35.00	90.00	0.00
6	OPS	600.00	0.00	35.00	90.00	0.00

17-4

CANDLEPOWER TABLE - LUMINAIRE CODE: V400S4MWE) TABLE NO. 36

HORZ. ANGLES (V 3R 17)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	295.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
-35.0		125	150	145	140	135	125	130	135	150
	175	175	150	135	130	125	135	140	145	150
	125	100	90	70	40	0	0	0	0	0
	0	0	0	40	70	90	100	125	150	
-25.0		250	270	275	280	285	275	275	280	310
	375	375	310	280	275	275	285	280	275	270
	250	230	200	180	175	160	105	90	40	40
	90	105	160	175	180	200	230	250	270	
-15.0		375	495	420	410	450	430	420	425	410
	490	490	410	425	420	430	450	410	420	405
	375	355	350	345	380	390	320	260	180	180
	260	320	390	380	345	350	355	375	405	
-5.0		500	600	700	750	775	850	780	750	875
	1060	1060	875	750	740	850	775	750	700	600
	500	500	550	575	600	550	450	400	360	360
	400	450	550	600	575	550	500	500	640	
5.0		750	1000	1750	2250	3100	3750	2200	1675	1900
	2200	2200	1900	1875	2200	3750	3100	2250	1750	1000
	750	775	810	840	825	750	650	625	600	600
	625	650	750	825	840	610	775	750	1000	
10.0		835	1250	3750	9500	17000	13000	4800	3400	3000
	3300	3300	3000	3400	4800	13000	17000	9500	3750	1250
	835	825	860	950	1000	840	800	775	750	750
	775	800	840	1000	950	860	825	835	1250	
15.0		1125	2600	17000	33500	30000	16000	10200	5200	4350
	4100	4100	4350	5200	10200	16000	30000	33500	17000	2600
	1125	1020	1000	1175	1275	950	900	950	925	925
	950	900	950	1275	1175	1000	1020	1125	2600	
20.0		2200	7000	20000	27000	24000	17500	10000	7500	6650
	7000	7000	6650	7500	10000	17500	24000	27000	20000	7000
	2230	1560	1500	1550	1550	1125	1050	1125	1125	1125
	1125	1050	1125	1550	1550	1500	1560	2200	7000	
25.0		2300	7000	14000	18000	18000	14500	10500	9200	9200
	12500	12500	9200	9200	10500	14500	18000	18000	14000	7000
	4300	2500	2250	2100	1850	1350	1400	1450	1500	1500
	1450	1400	1350	1850	2100	2250	2500	4300	[illegible]	

9/19-95

CANDLEPOWER TABLE - LUMINAIRE CODE: V400S4MWE1 TABLE NO. 36

HORZ. ANGLES (V 38 17)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
30.0		5575	8000	11000	14000	14500	13000	12500	12500	13750
	16000	16000	13750	12500	[illegible]	13000	14500	14000	11000	8000
	5575	5000	4025	2600	2100	1875	1800	1875	1925	1925
	1875	1800	1875	2100	2600	4025	5000	5575	6000	
35.0		6800	8200	9200	10200	12700	12500	14500	16000	16500
	17800	17800	16500	16000	14500	12500	12700	10200	9200	8200
	6800	5575	4900	3700	2800	2450	2400	2450	2475	2475
	2450	2400	2450	2800	3700	4900	5575	6800	8200	
45.0		6800	7600	8300	9300	11250	12500	14500	17000	17200
	16800	16400	17200	17000	14500	12500	11250	9300	8300	7600
	6800	5900	5250	4400	3700	3100	2900	2825	2700	2700
	2825	2900	3100	3700	4400	5250	5900	6800	7600	
55.0		5600	5750	7600	8600	9700	10400	12250	14000	14750
	15000	15000	14750	14000	12250	10400	9700	8600	7600	5750
	5600	5150	4750	4300	3900	3450	3250	3100	3000	3000
	3100	3250	3450	3900	4300	4750	5150	5600	5750	
65.0		4750	4900	5500	7800	8500	9000	9500	10500	11250
	12000	12000	11250	10500	9500	9000	8500	7800	5500	4900
	4750	4650	4300	4100	3950	3650	3600	3425	3350	3350
	3425	3600	3650	3950	4100	4300	4650	4750	4900	
75.0		4650	4825	5200	6500	7200	7700	8300	8600	9200
	9500	9500	9200	8600	8300	7700	7200	6500	5200	4825
	4650	4475	4200	4100	4000	3850	3750	3700	3650	3650
	3700	3750	3850	4000	4100	4200	4475	4650	4825	
85.0		4950	4950	5150	5500	6000	6300	6600	7000	7200
	7300	7300	7200	7000	6600	6300	6000	5500	5150	4950
	4900	4760	4650	4525	4450	4400	4350	4300	4270	4270
	4300	4350	4400	4450	4525	4650	4760	4900	4950	
90.0		5100	5100	5100	5100	5100	5100	5100	5100	5100
	5100	5100	5100	5100	5100	5100	5100	5100	2805	5100
	5100	5100	5100	5100	5100	5100	5100	5100	5100	5100
	5100	5100	5100	5100	5100	5100	5100	5100	5100	

19-6

TEST GRID POSITION AND SIZE - TEST GRID 1

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
-120.00	-30.00	.50	720.00	120.00	.50

NUMX	NUMYZ	ICOMP	AMETER	XGRID3	YGRID3	ZGRID3
15	11	-	0.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 181.8129087190
NUMBER OF POINTS = 165.0000000000

AVERAGE FOOTCANDLES = 1.1019964165
UNIFORMITY RATIO = 77.9604329834

MAXIMUM FOOTCANDLES = 5.2776914764
MINIMUM FOOTCANDLES = .0141340462

T74A PEP LTG--OF(6-POLE) 1X400HPS SP120 MH35 (020678 78/02/06 09.18.01 PAGE 1

TEST GRID 1 COORDINATES OF CORNER 1 -120.00 -30.00 .50
COORDINATES OF CORNER 2 720.00 120.00 .50
COORDINATES OF CORNER 3 720.00 -30.00 .50
COORDINATES OF CORNER 4 -120.00 120.00 .50

	X -120.00	X -60.00	X 0.00	X 60.00	X 120.00	X 180.00	X 240.00	X 300.00	X 360.00	X 420.00	
Y 120.00 Z .50	.0715	.0437	.1282	.1340	.1908	.1641	.1979	.1659	.1979	.1641	120.00 Y .50 Z
Y 105.00 Z .50	.1030	.1249	.2063	.2165	.3010	.2466	.3076	.2483	.3076	.2466	105.00 Y .50 Z
Y 90.00 Z .50	.1544	.1849	.3658	.3389	.5125	.3669	.5186	.3684	.5186	.3669	90.00 Y .50 Z
Y 75.00 Z .50	.2101	.3082	.7176	.5889	.9210	.6138	.9261	.6151	.9261	.6138	75.00 Y .50 Z
Y 60.00 Z .50	.2732	.5195	1.4003	1.0147	1.6693	1.0366	1.6722	1.0377	1.6722	1.0366	60.00 Y .50 Z
Y 45.00 Z .50	.2666	.7553	2.5252	1.4920	2.7873	1.5086	2.7905	1.5095	2.7905	1.5086	45.00 Y .50 Z
Y 30.00 Z .50	.1504	.9024	4.1262	1.7911	4.3051	1.8030	4.3074	1.8037	4.3076	1.8030	30.00 Y .50 Z
Y 15.00 Z .50	.0783	.7435	5.2005	1.4802	5.2761	1.4855	5.2777	1.4861	5.2777	1.4855	15.00 Y .50 Z
Y 0.00 Z .50	.0317	.4544	2.9453	.9630	2.9745	.9674	2.9760	.9679	2.9760	.9674	0.00 Y .50 Z
Y -15.00 Z .50	.0172	.3118	1.5131	.6191	1.5281	.6223	1.5294	.6228	1.5294	.6223	-15.00 Y .50 Z
Y -30.00 Z .50	.0141	.1641	.7063	.3239	.7194	.3270	.7195	.3274	.7195	.3270	-30.00 Y .50 Z

FMG HFC

19-8

TEST GRID 1

COORDINATES OF CORNER 1	-120.00	-30.00	.50
COORDINATES OF CORNER 2	720.00	120.00	.50
COORDINATES OF CORNER 3	720.00	-30.00	.50
COORDINATES OF CORNER 4	-120.00	120.00	.50

	X 480.00	X 540.00	X 600.00	X 660.00	X 720.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 120.00	.1908	.1340	.1282	.0837	.0715	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z
Y 105.00	.3010	.2165	.2063	.1249	.1030	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z
Y 90.00	.5125	.3349	.3658	.1849	.1544	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z
Y 75.00	.9210	.6280	.7176	.3082	.2101	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z
Y 60.00	1.6683	1.0147	1.4003	.5195	.2732	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z
Y 45.00	2.7873	1.4920	2.5252	.7553	.2666	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z
Y 30.00	4.3051	1.7911	4.1282	.9024	X .1804	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z
Y 15.00	5.2761	1.4802	5.2005	.7435	.0783	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z
Y 0.00	2.9745	.9630	2.9453	1X .4844	.0317	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z
Y -15.00	1.5281	.6191	1.5131	.3118	.0172	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z
Y -30.00	.7184	.3239	.7063	.1641	.0141	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z .50											0.00 Z

TEST GRID POSITION AND SIZE - TEST GRID 2

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
-120.00	-30.00	3.00	720.00	120.00	3.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
15	11	V	270.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 169.4166315215
NUMBER OF POINTS = 165.0000000000

AVERAGE FOOTCANDLES = 1.0267674638
UNIFORMITY RATIO = 0.0000000000

MAXIMUM FOOTCANDLES = 4.2671242940
MINIMUM FOOTCANDLES = 0.0000000000

19-10

TEST GRID 2 COORDINATES OF CORNER 1 -120.00 -30.00 3.00
COORDINATES OF CORNER 2 720.00 120.00 3.00
COORDINATES OF CORNER 3 720.00 -30.00 3.00
COORDINATES OF CORNER 4 -120.00 120.00 3.00

	X -120.00	X -60.00	X 0.00	X 60.00	X 120.00	X 180.00	X 240.00	X 300.00	X 360.00	X 420.00	
Y 120.00 Z 3.00	.2392	.2549	.4131	.4273	.6186	.5193	.6398	.5244	.6398	.5193	120.00 Y 3.00 Z
Y 105.00 Z 3.00	.2939	.3612	.5761	.6325	.8473	.7136	.8649	.7179	.8649	.7136	105.00 Y 3.00 Z
Y 90.00 Z 3.00	.3705	.4806	.8445	.8890	1.1970	.9541	1.2109	.9576	1.2109	.9541	90.00 Y 3.00 Z
Y 75.00 Z 3.00	.4085	.6731	1.3882	1.2928	1.7836	1.3408	1.7935	1.3433	1.7935	1.3408	75.00 Y 3.00 Z
Y 60.00 Z 3.00	.4111	.9700	2.3120	1.9055	2.7144	1.9361	2.7207	1.9379	2.7207	1.9361	60.00 Y 3.00 Z
Y 45.00 Z 3.00	.3027	1.1132	3.5303	2.2084	3.8275	2.2239	3.8314	2.2251	3.8314	2.2239	45.00 Y 3.00 Z
Y 30.00 Z 3.00	.1438	.8836	4.1243	1.7584	4.2652	1.7658	4.2671	1.7664	4.2671	1.7658	30.00 Y 3.00 Z
Y 15.00 Z 3.00	.0299	.3679	2.8107	.7332	2.8395	.7352	2.8402	.7355	2.8402	.7352	15.00 Y 3.00 Z
Y 0.00 Z 3.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y 3.00 Z
Y -15.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-15.00 Y 3.00 Z
Y -30.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-30.00 Y 3.00 Z

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275?

10-11

TEST GRID 2		X	Y	Z
	COORDINATES OF CORNER 1	-120.00	-30.00	3.00
	COO-DINATES OF CORNER 2	720.00	120.00	3.00
	COO-DINATES OF CORNER 3	720.00	-30.00	3.00
	COORDINATES OF CORNER 4	-120.00	120.00	3.00

		X 480.00	X 540.00	X 600.00	X 660.00	X 720.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y	120.00	.6186	.4[illegible]3	.4067	.2649	.2327	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	105.00	.8473	.632[illegible]	.5761	.3612	.2939	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	90.00	1.1970	.98[illegible]	.8445	.4806	.3705	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	75.00	1.7836	1.2928	1.3882	.6731	.4085	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	60.00	2.7144	1.9955	2.3120	.9700	.4111	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	45.00	3.8275	2.2064	3.5303	1.1132	.3027	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	30.00	~~4.2662~~	~~1.7584~~	~~4.1243~~	A.4836	.1438	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	15.00	2.8395	.7332	2.8107	.3679	.0299	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	0.00	A 6.0000	.0000	A .0000	.0000	.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	-15.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	-30.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z

TEST GRID POSITION AND SIZE - TEST GRID 3

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
-120.00	-30.00	3.00	120.00	120.00	3.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
15	11	V	150.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 80.3038014649
NUMBER OF POINTS = 165.0000000000

AVERAGE FOOTCANDLES = .4866897058
UNIFORMITY RATIO = 0.0000000000

MAXIMUM FOOTCANDLES = 1.8102136986
MINIMUM FOOTCANDLES = 0.0000000000

TEST GRID 3				
	COORDINATES OF CORNER 1	-120.00	-30.00	3.00
	COORDINATES OF CORNER 2	120.00	120.00	3.00
	COORDINATES OF CORNER 3	120.00	-30.00	3.00
	COORDINATES OF CORNER 4	-120.00	120.00	3.00

	X -120.00	X -60.00	X 0.00	X 60.00	X 120.00	X 180.00	X 240.00	X 300.00	X 360.00	X 420.00	
Y 120.00 Z 3.00	0.0000	0.0000	.0000	.0814	.2060	.2205	.2504	.2373	.2588	.2431	120.00 Y 3.00 Z
Y 105.00 Z 3.00	0.0000	0.0000	.0000	.1552	.3104	.2951	.3525	.3114	.3608	.3170	105.00 Y 3.00 Z
Y 90.00 Z 3.00	0.0000	0.0000	.0000	.2724	.4704	.4037	.5093	.4188	.5172	.4241	90.00 Y 3.00 Z
Y 75.00 Z 3.00	0.0000	0.0000	.0000	.4959	.6330	.6120	.6663	.6256	.6737	.6305	75.00 Y 3.00 Z
Y 60.00 Z 3.00	0.0000	0.0000	.0000	.9356	.8052	1.0284	.8319	1.0406	.8386	1.0450	60.00 Y 3.00 Z
Y 45.00 Z 3.00	0.0000	0.0000	.0000	1.4603	.7929	1.5232	.8151	1.5336	.8210	1.5376	45.00 Y 3.00 Z
Y 30.00 Z 3.00	0.0000	0.0000	XX .0000	1.7496	.5639	1.7949	.5805	1.8032	.5856 XV	1.8068	30.00 Y 3.00 Z
Y 15.00 Z 3.00	0.0000	0.0000	.0000	1.4612	.2301	1.4860	.2425	1.4934	.2474	1.4968	15.00 Y 3.00 Z
Y 0.00 Z 3.00	0.0000	0.0000	.0000	XX .8238	.0789	.8450	.0899	.8517	.0943	.8550 XV	0.00 Y 3.00 Z
Y -15.00 Z 3.00	0.0000	0.0000	.0000	.4587	.0456	.4756	.0552	.4817	.0594	.4849	-15.00 Y 3.00 Z
Y -30.00 Z 3.00	0.0000	0.0000	.0000	.2370	.0395	.2530	.0484	.2586	.0523	.2615	-30.00 Y 3.00 Z

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180° ⇐

TEST GRID 3

COORDINATES OF CORNER 1	-120.00	-30.00	3.00
COORDINATES OF CORNER 2	720.00	120.00	3.00
COORDINATES OF CORNER 3	720.00	-30.00	3.00
COORDINATES OF CORNER 4	-120.00	120.00	3.00

	X 480.00	X 540.00	X 600.00	X 660.00	X 720.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 120.00 Z 3.00	.2629	.2461	.2653	.2480	.2667	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 105.00 Z 3.00	.3647	.3199	.3670	.3216	.3683	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 90.00 Z 3.00	.5209	.4268	.5230	.4284	.5243	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 75.00 Z 3.00	.6771	.6330	.6790	.6345	.6803	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 60.00 Z 3.00	.8417	1.0473	.8435	1.0487	.8447	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 45.00 Z 3.00	.8238	1.5397	.8255	1.5411	.8267	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 30.00 Z 3.00	.5893	1.8089	.5899	1.8102 XY	.5910	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 15.00 Z 3.00	.2499	1.4988	.2515	1.5001	.2526	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 0.00 Z 3.00	.0969	.8569	.0985 XY	.8582	.0995	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -15.00 Z 3.00	.0617	.4866	.0632	.4878	.0642	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -30.00 Z 3.00	.0545	.2632	.0559	.2644	.0569	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

18-15

TEST GRID POSITION AND SIZE - TEST GRID 4

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
280.00	-25.00	.50	370.00	110.00	.50

NUMX	NUMYZ	ICOMP	AMETER	XGRID3	YGRID3	ZGRID3
10	28	0	0.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 397.3986925232
NUMBER OF POINTS = 280.0000000000

AVERAGE FOOTCANDLES = 1.4210667590
UNIFORMITY RATIO = 6.5367601814

MAXIMUM FOOTCANDLES = 6.2776914764
MINIMUM FOOTCANDLES = .2173961901

19-16

TEST GRID 4

COORDINATES OF CORNER 1	280.00	-25.00	.50
COORDINATES OF CORNER 2	370.00	110.00	.50
COORDINATES OF CORNER 3	370.00	-25.00	.50
COORDINATES OF CORNER 4	280.00	110.00	.50

	X 280.00	X 290.00	X 300.00	X 310.00	X 320.00	X 330.00	X 340.00	X 350.00	X 360.00	X 370.00	
Y 110.00 Z .50	.2296	.2175	.2174	.2175	.2296	.2394	.2505	.2591	.2637	.2588	110.00 Y .50 Z
Y 105.00 Z .50	.2620	.2474	.2483	.2474	.2620	.2768	.2891	.3023	.3076	.3020	105.00 Y .50 Z
Y 100.00 Z .50	.2995	.2827	.2835	.2827	.2995	.3151	.3344	.3548	.3609	.3546	100.00 Y .50 Z
Y 95.00 Z .50	.3410	.3266	.3234	.3266	.3410	.3605	.3904	.4187	.4259	.4185	95.00 Y .50 Z
Y 90.00 Z .50	.3916	.3793	.3684	.3793	.3916	.4142	.4581	.5048	.5136	.5046	90.00 Y .50 Z
Y 85.00 Z .50	.4534	.4422	.4215	.4422	.4534	.4905	.5426	.6059	.6359	.6057	85.00 Y .50 Z
Y 80.00 Z .50	.5302	.5169	.5063	.5169	.5302	.5793	.6424	.7323	.7643	.7321	80.00 Y .50 Z
Y 75.00 Z .50	.6325	.6068	.6151	.6068	.6325	.6825	.7514	.8841	.9261	.8839	75.00 Y .50 Z
Y 70.00 Z .50	.7470	.7204	.7432	.7204	.7470	.8021	.8955	1.0573	1.1153	1.0572	70.00 Y .50 Z
Y 65.00 Z .50	.8749	.8689	.8836	.8689	.8749	.9459	1.0728	1.2728	1.3552	1.2727	65.00 Y .50 Z
Y 60.00 Z .50	1.0237	1.0211	$\boxed{1.0377}$	1.0211	1.0237	1.1203	1.2870	1.5459	1.6722	1.5457	60.00 Y .50 Z
Y 55.00 Z .50	1.2037	1.1814	1.1908	1.1814	1.2037	1.3205	1.5521	1.8474	2.0214	1.8472	55.00 Y .50 Z
Y 50.00 Z .50	1.3913	1.3507	1.3494	1.3607	1.3913	1.5583	1.8788	2.2230	2.4148	2.2228	50.00 Y .50 Z
Y 45.00 Z .50	1.5718	1.5190	1.5095	1.5190	1.5718	1.8314	2.3028	2.5968	2.7905	2.5967	45.00 Y .50 Z
Y 40.00 Z .50	1.7425	1.6668	1.6495	1.6668	1.7425	2.0928	2.6124	3.0298	3.2197	3.0297	40.00 Y .50 Z
Y 35.00 Z .50	1.9021	1.7973	1.7342	1.7973	1.9021	2.2407	2.9361	3.6046	3.7486	3.6045	35.00 Y .50 Z

1.8 FC

2.0 FC

T74A PER LTG--UF(6-POLE) 1X400HPS SP120 MH35 (020678 78/02/06 09.18.01 PAGE 7

TEST GRID 4 COORDINATES OF CORNER 1 280.00 -25.00 .50
COORDINATES OF CORNER 2 370.00 110.00 .50
COORDINATES OF CORNER 3 370.00 -25.00 .50
COORDINATES OF CORNER 4 280.00 110.00 .50

		X 280.00	X 290.00	X 300.00	X 310.00	X 320.00	X 330.00	X 340.00	X 350.00	X 360.00	X 370.00		
Y Z	30.00 .50	2.0003	1.8195	1.8037	1.8195	2.0003	2.3575	3.2409	4.1485	4.3074	4.1485	30.00 .50	Y Z
Y Z	25.00 .50	1.9993	1.7745	1.7670	1.7745	1.9993	2.5286	3.3823	4.5376	4.8974	4.5375	25.00 .50	Y Z
Y Z	20.00 .50	1.8879	1.6733	1.6431	1.6733	1.8879	2.5426	3.3063	4.6483	5.2337	4.6482	20.00 .50	Y Z
Y Z	15.00 .50	1.7662	1.5205	1.4861	1.5205	1.7662	2.3443	3.2658	4.2983	5.2777	4.2982	15.00 .50	Y Z
Y Z	10.00 .50	1.6353	1.3602	1.3028	1.3602	1.6353	2.1769	3.0600	4.0160	5.0414	4.0159	10.00 .50	Y Z
Y Z	5.00 .50	1.5063	1.2111	1.1213	1.2042	1.4997	1.9873	2.5087	3.5251	4.5125	3.5250	5.00 .50	Y Z
Y Z	0.00 .50	1.3662	1.0827	.9679	1.0827	1.3662	1.7580	2.0431	2.4735	2.2760	2.4734	0.00 .50	Y Z
Y Z	-5.00 .50	1.1877	.9301	.7940	.9301	1.1877	1.5574	1.8686	2.1248	2.3026	2.1247	-5.00 .50	Y Z
Y Z	-10.00 .50	1.0039	.7462	.7167	.7462	1.0039	1.3354	1.6019	1.8333	1.8664	1.8332	-10.00 .50	Y Z
Y Z	-15.00 .50	.8562	.6687	.6228	.6687	.8562	1.1341	1.3283	1.4628	1.5294	1.4627	-15.00 .50	Y Z
Y Z	-20.00 .50	.7080	.5529	.5149	.5529	.7080	.8910	1.0487	1.1641	1.2045	1.1640	-20.00 .50	Y Z
Y Z	-25.00 .50	.5560	.4488	.4154	.4488	.5560	.6746	.7982	.9004	.9308	.9004	-25.00 .50	Y Z

19-12

TEST GRID POSITION AND SIZE - TEST GRID 5

YGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
300.00	0.00	.50	360.00	30.00	.50

NUMX	NU4YZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
7	7	H	0.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 129.0575729385
NUMBER OF POINTS = 049.0000000000

AVERAGE FOOTCANDLES = 2.6334280192
UNIFORMITY RATIO = 2.7211599489

See Next Page

MAXIMUM FOOTCANDLES = 5.2776914764
MINIMUM FOOTCANDLES = .9679063593

TEST GRID 5 COORDINATES OF CORNER 1 300.00 0.00 .50
COORDINATES OF CORNER 2 360.00 30.00 .50
COORDINATES OF CORNER 3 360.00 0.00 .50
COORDINATES OF CORNER 4 300.00 30.00 .50

	X 300.00	X 310.00	X 320.00	X 330.00	X 340.00	X 350.00	X 360.00	X 0.00	X 0.00	X 0.00	
Y 30.00 Z .50	1.8037	1.8195	2.0003	2.3475	3.2409	4.1485	4.3074	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 25.00 Z .50	1.7670	1.7745	1.9993	2.5286	3.3823	4.5376	4.8974	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 20.00 Z .50	1.6431	1.6733	1.8879	2.5425	3.3063	4.6463	5.2337	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 15.00 Z .50	1.4661	1.5205	1.7662	2.3443	3.2658	4.2983	5.2777	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 10.00 Z .50	1.3028	1.3602	1.6353	2.1769	3.0600	4.0160	5.0418	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 5.00 Z .50	1.1213	1.2042	1.4997	1.9673	2.5087	3.5251	4.5125	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 0.00 Z .50	.9679	1.0427	1.3662	1.7580	2.0431	2.4735	2.9760	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

30' deep Test Grid (uniformity ratios) HEC

TEST GRID POSITION AND SIZE - TEST GRID 6

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
300.00	0.00	.50	360.00	60.00	.50

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
7	13	[illegible]	0.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 208.3573751279
NUMBER OF POINTS = 91.0000000000

AVERAGE FOOTCANDLES = 2.2896414949
UNIFORMITY RATIO = 2.3655609481

See Next Page

MAXIMUM FOOTCANDLES = 5.2776914764
MINIMUM FOOTCANDLES = .9679063593

TEST GRID 6 COORDINATES OF CORNER 1 300.00 0.00 .50
COORDINATES OF CORNER 2 360.00 60.00 .50
COORDINATES OF CORNER 3 360.00 0.00 .50
COORDINATES OF CORNER 4 300.00 60.00 .50

	X 300.00	X 310.00	X 320.00	X 330.00	X 340.00	X 350.00	X 360.00	X 0.00	X 0.00	X 0.00	
Y 60.00 Z .50	1.0377	1.0211	1.0237	1.1203	1.2870	1.5459	1.6722	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 55.00 Z .50	1.1908	1.1814	1.2037	1.3205	1.5521	1.8474	2.0214	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 50.00 Z .50	1.3494	1.3607	1.3913	1.5583	1.8788	2.2230	2.4148	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 45.00 Z .50	1.5095	1.5190	1.5718	1.8314	2.3020	2.5968	2.7905	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 40.00 Z .50	1.6495	1.6668	1.7425	2.0928	2.6124	3.0298	3.2197	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 35.00 Z .50	1.7342	1.7973	1.9021	2.2407	2.9361	3.6046	3.7486	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 30.00 Z .50	1.8037	1.8195	2.0003	2.3575	3.2409	4.1485	4.3074	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 25.00 Z .50	1.7670	1.7745	1.9993	2.5286	3.3823	4.5376	4.8974	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 20.00 Z .50	1.6431	1.6733	1.8879	2.5426	3.3063	4.6483	5.2337	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 15.00 Z .50	1.4861	1.5205	1.7662	2.3443	3.2658	4.2983	5.2777	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 10.00 Z .50	1.3028	1.3602	1.6353	2.1769	3.0600	4.0160	5.0418	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 5.00 Z .50	1.1213	1.2042	1.4997	1.9673	2.5087	3.5251	4.5125	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 0.00 Z .50	.9679	1.0827	1.3662	1.7580	2.0431	2.4735	2.9760	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

60' deep Test Grid - HFC

TEST GRID POSITION AND SIZE - TEST GRID 7

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
300.00	0.00	-5.50	360.00	60.00	-5.50

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
7	13	4	0.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 184.2650220341
NUMBER OF POINTS = 91.0000000000

AVERAGE FOOTCANDLES = 2.0248463960
UNIFORMITY RATIO = 1.9698849710

MAXIMUM FOOTCANDLES = 4.0093280782
MINIMUM FOOTCANDLES = 1.0502371592

TEST GRID 7

COORDINATES OF CORNER 1	300.00	0.00	-5.50
COORDINATES OF CORNER 2	360.00	60.00	-5.50
COORDINATES OF CORNER 3	360.00	0.00	-5.50
COORDINATES OF CORNER 4	300.00	60.00	-5.50

	X 300.00	X 310.00	X 320.00	X 330.00	X 340.00	X 350.00	X 360.00	X 0.00	X 0.00	X 0.00	
Y 60.00 Z -5.50	1.0502	1.0773	1.1717	1.3459	1.5790	1.7987	1.8921	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 55.00 Z -5.50	1.1767	1.2033	1.3254	1.5591	1.8508	2.0628	2.1732	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 50.00 Z -5.50	1.3051	1.3212	1.4654	1.7780	2.1049	2.3219	2.4120	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 45.00 Z -5.50	1.4320	1.4381	1.5855	1.9502	2.3791	2.6174	2.6997	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 40.00 Z -5.50	1.5215	1.5464	1.6677	2.0861	2.6432	2.9989	3.0373	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 35.00 Z -5.50	1.5573	1.6407	1.7732	2.1813	2.8785	3.3160	3.3791	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 30.00 Z -5.50	1.5728	1.6960	1.8469	2.2479	2.9314	3.5749	3.7318	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 25.00 Z -5.50	1.5123	1.5297	1.8321	2.2961	2.9064	3.7011	3.9579	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 20.00 Z -5.50	1.4230	1.4693	1.7297	2.2311	2.7386	3.5779	4.0093	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 15.00 Z -5.50	1.3361	1.4009	1.6258	2.0632	2.6871	3.2570	3.9346	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 10.00 Z -5.50	1.2643	1.3274	1.5212	1.9071	2.4967	3.0541	3.6666	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 5.00 Z -5.50	1.1858	1.2421	1.4180	1.6450	1.8737	2.6208	3.2742	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 0.00 Z -5.50	1.0836	1.1321	1.3156	1.4476	1.6118	1.9233	2.2234	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

60 ft loop test grid - equivalent to setting mounting height at 40 ft.

TEST GRID POSITION AND SIZE - TEST GRID H

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
280.00	60.00	0.00	370.00	60.00	130.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
10	14	H	0.00	370.00	60.00	0.00

TOTAL FOOTCANDLES = 24.8752909049
NUMBER OF POINTS = 140.0000000000

AVERAGE FOOTCANDLES = .1776806493
UNIFORMITY RATIO = 63.1761768383

MAXIMUM FOOTCANDLES = 1.7102531606
MINIMUM FOOTCANDLES = .0028124628

TEST GRID 8

COORDINATES OF CORNER 1	280.00	60.00	0.00
COORDINATES OF CORNER 2	370.00	60.00	130.00
COORDINATES OF CORNER 3	370.00	60.00	0.00
COORDINATES OF CORNER 4	280.00	60.00	130.00

	X 280.00	X 290.00	X 300.00	X 310.00	X 320.00	X 330.00	X 340.00	X 350.00	X 360.00	X 370.00	
Y 60.00 Z 130.00	.0050	.0050	.0050	.0050	.0050	.0050	.0049	.0049	.0028	.0048	60.00 Y 130.00 Z
Y 60.00 Z 120.00	.0052	.0052	.0052	.0052	.0052	.0053	.0053	.0079	.0079	.0078	60.00 Y 120.00 Z
Y 60.00 Z 110.00	.0054	.0054	.0054	.0054	.0054	.0086	.0089	.0090	.0090	.0089	60.00 Y 110.00 Z
Y 60.00 Z 100.00	.0097	.0054	.0054	.0054	.0097	.0099	.0099	.0099	.0099	.0098	60.00 Y 100.00 Z
Y 60.00 Z 90.00	.0110	.0111	.0165	.0111	.0110	.0109	.0107	.0105	.0104	.0105	60.00 Y 90.00 Z
Y 60.00 Z 80.00	.0207	.0210	.0210	.0210	.0207	.0202	.0109	.0106	.0104	.0105	60.00 Y 80.00 Z
Y 60.00 Z 70.00	.0245	.0243	.0241	.0243	.0245	.0248	.0257	.0277	.0290	.0277	60.00 Y 70.00 Z
Y 60.00 Z 60.00	.0253	.0243	.0240	.0243	.0253	.0266	.0282	.0319	.0342	.0318	60.00 Y 60.00 Z
Y 60.00 Z 50.00	.0233	.0230	.0233	.0230	.0233	.0243	.0257	.0286	.0307	.0286	60.00 Y 50.00 Z
Y 60.00 Z 40.00	.0142	.0149	.0160	.0149	.0142	.0144	.0162	.0192	.0209	.0192	60.00 Y 40.00 Z
Y 60.00 Z 30.00	.0292	.0335	.0381	.0335	.0292	.0292	.0317	.0367	.0399	.0367	60.00 Y 30.00 Z
Y 60.00 Z 20.00	.2915	.3621	.4214	.3621	.2915	.2433	.2148	.2104	.2111	.2103	60.00 Y 20.00 Z
Y 60.00 Z 10.00	.7853	.8630	.8271	.8630	.7853	.7095	.6673	.7236	.7924	.7235	60.00 Y 10.00 Z
Y 60.00 Z 0.00	1.0370	1.0236	1.0392	1.0236	1.0370	1.1398	1.3157	1.5793	1.7103	1.5791	60.00 Y 0.00 Z

Vertical Grid @ Y = 60 ft (parallel to plane of fence(s) or to plane of pole line)

TEST GRID POSITION AND SIZE - TEST GRID 9

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
300.00	-30.00	0.00	300.00	140.00	130.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
18	14	4	0.00	300.00	140.00	0.00

TOTAL FOOTCANDLES = 36.1035877540
NUMBER OF POINTS = 252.0000000000

AVERAGE FOOTCANDLES = .1432682054
UNIFORMITY RATIO = 42.1966111057

MAXIMUM FOOTCANDLES = 2.4098000496
MINIMUM FOOTCANDLES = .0033952538

19-27

TEST GRID 9 COORDINATES OF CORNER 1 300.00 -30.00 0.00
COORDINATES OF CORNER 2 300.00 140.00 130.00
COORDINATES OF CORNER 3 300.00 140.00 0.00
COORDINATES OF CORNER 4 300.00 -30.00 130.00

	(-30y) X 300.00	X 300.00	X 300.00	(0y) X 300.00	X 300.00	(20y) X 300.00	X 300.00	(40y) X 300.00	X 300.00	(60y) X 300.00	
Y -30.00 Z 130.00	.0045	.0047	.0048	.0049	.0051	.0051	.0051	.0051	.0050	.0050	60.00 Y 130.00 Z
Y -30.00 Z 120.00	.0048	.0049	.0051	.0052	.0053	.0054	.0054	.0053	.0053	.0052	60.00 Y 120.00 Z
Y -30.00 Z 110.00	.0050	.0051	.0053	.0054	.0055	.0056	.0056	.0055	.0055	.0054	60.00 Y 110.00 Z
Y -30.00 Z 100.00	.0050	.0051	.0053	.0055	.0056	.0056	.0056	.0056	.0055	.0054	60.00 Y 100.00 Z
Y -30.00 Z 90.00	.0048	.0050	.0052	.0053	.0054	.0055	.0055	.0054	.0054	.0165	60.00 Y 90.00 Z
Y -30.00 Z 80.00	.0151	.0046	.0048	.0050	.0051	.0052	.0232	.0232	.0224	.0210	60.00 Y 80.00 Z
Y -30.00 Z 70.00	.0225	.0256	.0288	.0322	.0336	.0329	.0316	.0299	.0271	.0241	60.00 Y 70.00 Z
Y -30.00 Z 60.00	.0278	.0319	.0362	.0396	.0407	.0389	.0357	.0329	.0284	.0240	60.00 Y 60.00 Z
Y -30.00 Z 50.00	.0271	.0304	.0339	.0374	.0389	.0373	.0340	.0310	.0270	.0233	60.00 Y 50.00 Z
Y -30.00 Z 40.00	.0136	.0149	.0161	.0183	.0209	.0217	.0207	.0193	.0178	.0134	60.00 Y 40.00 Z
Y -30.00 Z 30.00	.0187	.0215	.0235	.0281	.0405	.0509	.0520	.0513	.0452	.0246	60.00 Y 30.00 Z
Y -30.00 Z 20.00	.0629	.0740	.0880	.1506	.6259	1.2709	1.4044	1.0816	.6756	.4212	60.00 Y 20.00 Z
Y -30.00 Z 10.00	.1508	.2015	.3233	.6442	1.3875	2.1924	2.4008	1.9613	1.3702	.8271	60.00 Y 10.00 Z
Y -30.00 Z 0.00	.3409	.5371	.7375	.9801	1.3004	1.6219	1.7859	1.6410	1.3412	1.0392	60.00 Y 0.00 Z

Vertical Grid @ X = 300 ft (perpendicular to plane of the pole line).

TEST GRID 9

COORDINATES OF CORNER 1	300.00	-30.00	0.00
COORDINATES OF CORNER 2	300.00	140.00	130.00
COORDINATES OF CORNER 3	300.00	140.00	0.00
COORDINATES OF CORNER 4	300.00	-30.00	130.00

(70y) (120)y

	X 300.00	X 300.00	X 300.00	X 300.00	X 300.00	X 300.00	X 300.00	X 300.00	X 0.00	X 0.00	
Y 70.00 Z 130.00	.0049	.0049	.0047	.0046	.0044	.0043	.0082	.0081	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 120.00	.0051	.0050	.0048	.0047	.0094	.0094	.0092	.0090	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 110.00	.0052	.0051	.0110	.0111	.0110	.0107	.0102	.0097	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 100.00	.0052	.0133	.0132	.0128	.0123	.0116	.0109	.0102	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 90.00	.0165	.0159	.0151	.0141	.0132	.0122	.0113	.0103	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 80.00	.0197	.0181	.0165	.0150	.0136	.0123	.0111	.0100	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 70.00	.0214	.0188	.0166	.0146	.0130	.0116	.0106	.0097	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 60.00	.0203	.0180	.0158	.0139	.0123	.0108	.0096	.0087	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 50.00	.0192	.0159	.0134	.0114	.0098	.0085	.0075	.0068	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 40.00	.0121	.0092	.0073	.0061	.0051	.0044	.0038	.0034	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 30.00	.0246	.0162	.0116	.0092	.0075	.0062	.0053	.0046	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 20.00	.2176	.1093	.0628	.0453	.0340	.0264	.0213	.0179	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 10.00	.5484	.3452	.2143	.1445	.1029	.0774	.0606	.0491	0.0000	0.0000	0.00 Y 0.00 Z
Y 70.00 Z 0.00	.7498	.5143	.3740	.2892	.2229	.1713	.1332	.1080	0.0000	0.0000	0.00 Y 0.00 Z

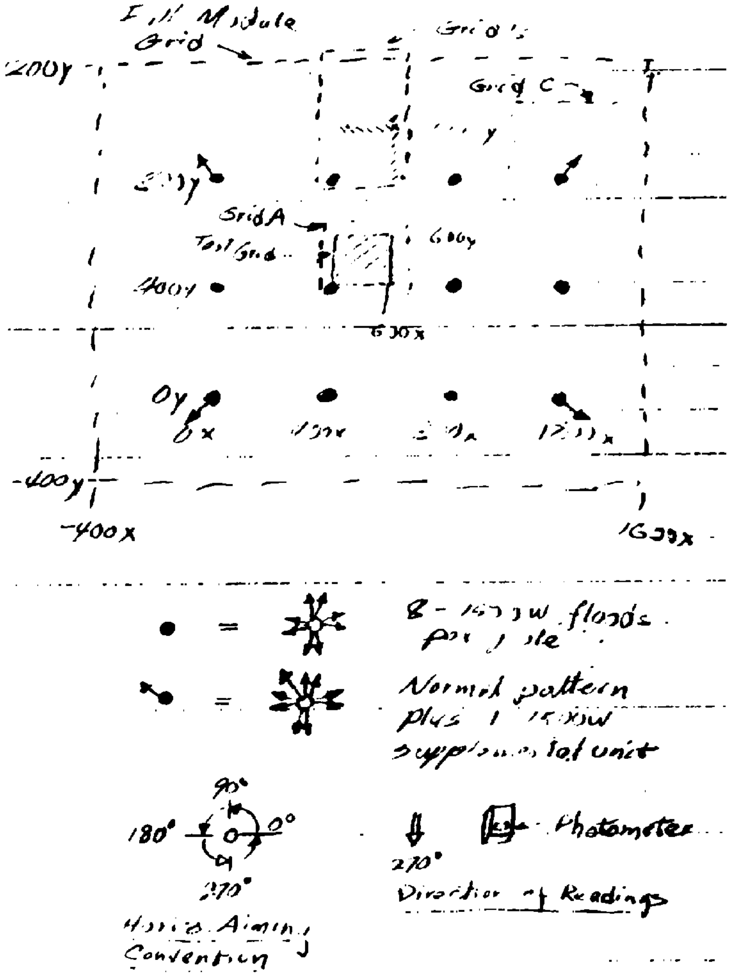
END OF RUN 78/02/06 09.18.46

19-29

```
FULL  DAYFILE.  78/02/06. 09.18.47.*09.17.52* PAGE    1
09.   52.JOB,T1320.
09.17.53.ACCOUNT,HCED(A1).
09.17.53.COMMENT.7120212012
09.17.53.COMMENT.CHARGE THIS JOB FOR PRINTING ONL
09.17.53.*
09.17.54.ATTACH(TAPE1=CANDLEM/M=R)
09.17.54.GET(TAPE2=LIGHTIT)
09.17.55.REWIND(TAPE1,TAPE2)
09.17.55.PURGE(LIGHTIT)
09.17.55.COPYSHF(TAPE2,OUTPUT)
09.17.56. END OF INFORMATION ENCOUNTERED.
09.17.56.REWIND(TAPE2)
09.17.56.GET(LIGHT10)
09.17.58.RFL(70000)
09.17.59.LIGHT10(TAPE2)
09.18.01.  CM LWA+1 = 52246B, LOADER USED  66600B
09.18.46.     STOP
09.18.46.     20.278 CP SECONDS EXECUTION TIME
09.18.46.RFL(10000)
09.18.47.RETURN(TAPE1,TAPE2,LIGHT10)
09.18.47.CTIME     21.681 SECS.
09.18.47.DAYFILE.
```

19-30

00100	0000	1	1			
00110	TF302A	4L:4W(12-POLE)	(END 10 J+KL)	4X15000	5400	MH40 - (021778)
00120	H150065F2	0.95	0.8	1.00		
00130	9999999999					
00500	H150065F2	0.00	0.00	40.00	[illegible]	60.00
00520	H150065F2	0.00	0.00	40.00	15.00	60.00
00530	H150065F2	0.00	0.00	40.00	75.00	60.00
00540	H150065F2	0.00	0.00	40.00	105.00	60.00
00550	H150065F2	0.00	0.00	40.00	165.00	60.00
00560	H150065F2	0.00	0.00	40.00	195.00	60.00
00570	H150065F2	0.00	0.00	40.00	255.00	60.00
00580	H150065F2	0.00	0.00	40.00	285.00	60.00
00590	H150065F2	0.00	0.00	40.00	345.00	60.00
00600	H150065F2	400.00	0.00	40.00	15.00	60.00
00610	H150065F2	400.00	0.00	40.00	75.00	60.00
00620	H150065F2	400.00	0.00	40.00	105.00	60.00
00630	H150065F2	400.00	0.00	40.00	165.00	60.00
00640	H150065F2	400.00	0.00	40.00	195.00	60.00
00650	H150065F2	400.00	0.00	40.00	255.00	60.00
00660	H150065F2	400.00	0.00	40.00	285.00	60.00
00670	H150065F2	400.00	0.00	40.00	345.00	60.00
00680	H150065F2	800.00	0.00	40.00	15.00	60.00
00690	H150065F2	800.00	0.00	40.00	75.00	60.00
00700	H150065F2	800.00	0.00	40.00	105.00	60.00
00710	H150065F2	800.00	0.00	40.00	165.00	60.00
00720	H150065F2	800.00	0.00	40.00	195.00	60.00
00730	H150065F2	800.00	0.00	40.00	255.00	60.00
00740	H150065F2	800.00	0.00	40.00	285.00	60.00
00750	H150065F2	800.00	0.00	40.00	345.00	60.00
00760	H150065F2	1200.00	0.00	40.00	15.00	60.00
00770	H150065F2	1200.00	0.00	40.00	75.00	60.00
00780	H150065F2	1200.00	0.00	40.00	105.00	60.00
00790	H150065F2	1200.00	0.00	40.00	165.00	60.00
00800	H150065F2	1200.00	0.00	40.00	195.00	60.00
00810	H150065F2	1200.00	0.00	40.00	255.00	60.00
00820	H150065F2	1200.00	0.00	40.00	285.00	60.00
00830	H150065F2	1200.00	0.00	40.00	345.00	60.00
00840	H150065F2	1200.00	0.00	40.00	315.00	60.00
00860	H150065F2	0.00	400.00	40.00	15.00	60.00
00870	H150065F2	0.00	400.00	40.00	75.00	60.00
00880	H150065F2	0.00	400.00	40.00	105.00	60.00
00890	H150065F2	0.00	400.00	40.00	165.00	60.00
00900	H150065F2	0.00	400.00	40.00	195.00	60.00
00910	H150065F2	0.00	400.00	40.00	255.00	60.00
00920	H150065F2	0.00	400.00	40.00	285.00	60.00
00930	H150065F2	0.00	400.00	40.00	345.00	60.00
00940	H150065F2	400.00	400.00	40.00	15.00	60.00
00950	H150065F2	400.00	400.00	40.00	75.00	60.00
00960	H150065F2	400.00	400.00	40.00	105.00	60.00
00970	H150065F2	400.00	400.00	40.00	165.00	60.00
00980	H150065F2	400.00	400.00	40.00	195.00	60.00
00990	H150065F2	400.00	400.00	40.00	255.00	60.00
01000	H150065F2	400.00	400.00	40.00	285.00	60.00



ATTACHMENT 20

20-1

01010	H15CQ65GE2	400.00	400.00	40.00	345.00	60.00
01020	H15CQ65GE2	800.00	400.00	40.00	15.00	60.00
01030	H15CQ65GE2	800.00	400.00	40.00	75.00	60.00
01040	H15CQ65GE2	800.00	400.00	40.00	105.00	60.00
01050	H15CQ65GE2	800.00	400.00	40.00	165.00	60.00
01060	H15CQ65GE2	800.00	400.00	40.00	195.00	60.00
01070	H15CQ65GE2	800.00	400.00	40.00	255.00	60.00
01080	H15CQ65GE2	800.00	400.00	40.00	285.00	60.00
01090	H15CQ65GE2	800.00	400.00	40.00	345.00	60.00
01100	H15CQ65GE2	1200.00	400.00	40.00	15.00	60.00
01110	H15CQ65GE2	1200.00	400.00	40.00	75.00	60.00
01120	H15CQ65GE2	1200.00	400.00	40.00	105.00	60.00
01130	H15CQ65GE2	1200.00	400.00	40.00	165.00	60.00
01140	H15CQ65GE2	1200.00	400.00	40.00	195.00	60.00
01150	H15CQ65GE2	1200.00	400.00	40.00	255.00	60.00
01160	H15CQ65GE2	1200.00	400.00	40.00	285.00	60.00
01170	H15CQ65GE2	1200.00	400.00	40.00	345.00	60.00
01190	H15CQ65GE2	0.00	800.00	40.00	135.00	60.00
01200	H15CQ65GE2	0.00	800.00	40.00	15.00	60.00
01210	H15CQ65GE2	0.00	800.00	40.00	75.00	60.00
01220	H15CQ65GE2	0.00	800.00	40.00	105.00	60.00
01230	H15CQ65GE2	0.00	800.00	40.00	165.00	60.00
01240	H15CQ65GE2	0.00	800.00	40.00	195.00	60.00
01250	H15CQ65GE2	0.00	800.00	40.00	255.00	60.00
01260	H15CQ65GE2	0.00	800.00	40.00	285.00	60.00
01270	H15CQ65GE2	0.00	800.00	40.00	345.00	60.00
01280	H15CQ65GE2	400.00	800.00	40.00	15.00	60.00
01290	H15CQ65GE2	400.00	800.00	40.00	75.00	60.00
01300	H15CQ65GE2	400.00	800.00	40.00	105.00	60.00
01310	H15CQ65GE2	400.00	800.00	40.00	165.00	60.00
01320	H15CQ65GE2	400.00	800.00	40.00	195.00	60.00
01330	H15CQ65GE2	400.00	800.00	40.00	255.00	60.00
01340	H15CQ65GE2	400.00	800.00	40.00	285.00	60.00
01350	H15CQ65GE2	400.00	800.00	40.00	345.00	60.00
01360	H15CQ65GE2	800.00	800.00	40.00	15.00	60.00
01370	H15CQ65GE2	800.00	800.00	40.00	75.00	60.00
01380	H15CQ65GE2	800.00	800.00	40.00	105.00	60.00
01390	H15CQ65GE2	800.00	800.00	40.00	165.00	60.00
01400	H15CQ65GE2	800.00	800.00	40.00	195.00	60.00
01410	H15CQ65GE2	800.00	800.00	40.00	255.00	60.00
01420	H15CQ65GE2	800.00	800.00	40.00	285.00	60.00
01430	H15CQ65GE2	800.00	800.00	40.00	345.00	60.00
01440	H15CQ65GE2	1200.00	800.00	40.00	15.00	60.00
01450	H15CQ65GE2	1200.00	800.00	40.00	75.00	60.00
01460	H15CQ65GE2	1200.00	800.00	40.00	105.00	60.00
01470	H15CQ65GE2	1200.00	800.00	40.00	165.00	60.00
01480	H15CQ65GE2	1200.00	800.00	40.00	195.00	60.00
01490	H15CQ65GE2	1200.00	800.00	40.00	255.00	60.00
01500	H15CQ65GE2	1200.00	800.00	40.00	285.00	60.00

Luminaire H15CQ65GE2:
General Electric Cat # GF25G006
1510W Quartz iodine floodlight
NEMA 6x5 beam pattern

20-2

01510		H15C065-F2	1200.00	800.00	40.00	345.00	60.00		
01520		H15C065-F2	1200.00	800.00	40.00	65.00	60.00		
01540		9999999999							
02000	1	-400.00	-400.00	3.00	1600.00	1200.00	3.00		FMG - VFC 270° ⇓
02010		11	0	V	270.00	0.00	0.00	0.00	
02020	2	-400.00	-400.00	3.00	1600.00	1200.00	3.00		FMG - VFC 180° ⇐
02030		11	0	V	180.00	0.00	0.00	0.00	
02040	3	-400.00	-400.00	0.50	1600.00	1200.00	0.50		FMG - HFC
02050		11	0	V	0.00	0.00	0.00	0.00	
02054	4	-400.00	-400.00	3.00	1600.00	1200.00	3.00		FMG - VFC 225°
02056		11	0	V	225.00	0.00	0.40	0.00	
02060	5	375.00	380.00	3.00	700.00	640.00	3.00		GA - VFC 270° ⇓
02070		14	14	V	270.00	0.00	0.00	0.00	
02080	6	400.00	400.00	3.00	600.00	600.00	3.00		TG - VFC 270° ⇓
02090		9	11	V	270.00	0.00	0.00	0.00	
02100	7	375.00	380.00	3.00	700.00	640.00	3.00		GA - VFC 180° ⇐
02110		14	14	V	180.00	0.00	0.00	0.00	
02120	8	375.00	380.00	0.50	700.00	640.00	0.50		GA - HFC
02130		14	14	V	0.00	0.00	0.00	0.00	
02140	9	400.00	750.00	3.00	625.00	1320.00	3.00		SB - VFC 270° ⇓
02150		10	24	V	270.00	0.00	0.00	0.00	
02160	10	400.00	1000.00	0.00	600.00	1000.00	120.00		Vertical Grid - VFC 270° ⇓ @ Y = 1000'
02170		9	11	V	270.00	500.00	1000.00	0.00	
02180	11	400.00	760.00	0.00	600.00	1040.00	120.00		Vertical Grid VFC 0° ⇒ @ X = 600'
02190		14	13	V	0.00	500.00	1040.00	0.00	
02200	12	1100.00	790.00	3.00	1575.00	1040.00	3.00		GC - VFC 270° ⇓
02210		20	14	V	270.00	0.00	0.00	0.00	
02220		9999999999							

TF302A *LIMR(12-POLE) (END ANNUAL PA1500) 5400 8490 - (78/02/17 09.09.08 PAGE 1

```
TSW1 =  1   1=PRINT CANDLEPOWER TABLES
TSW2 =  1   1=DISK DIRECTORY PRINT
TSW3 =  0   1=PRINT EACH POINT AFTER CALCULATION
TSW4 =  0   1=PRINT + ZERO GRID AFTER EACH LIGHT
TSW5 =  0   1=PRINT ALL CANDLEPOWER TABLES
TSW6 =  0   1=USE TS PAGE CHANGES

IOEV1 = 1   CANDLEPOWER TABLES
IOEV2 = 98  DESIGN INPUT
IOEV3 = 0
IOEV4 = 0
IOEV5 = 0
IOEV6 = 0
```

NO.	LUMID	NO.	LUMID	NO.	LUMID	NO.	LUMID
1	H15C065GF3	2	H500065GF2	3	V250S3MAE1	4	V180L4SAE1
5	V180L4M4F2	6	H15C065LA1	7	H15C065H01	8	V35WL4MN01
9	V55WL45M01	10	H10CS76CH1	11	V150S4LLA1	12	H15C065GE2
13	H90LS65M01	14	H180L76S01	15	H10CS75PU1	16	H10CS76CH2
17	H400S64CH1	18	V10CS76CH1	19	H20CX76H01	20	H300S65GF1
21	H400S76SY1	22	H250S76SF1	23	H15C066GF1	24	H400S75HF1
25	H300S56WG2	26	H400S55PU1	27	H250S75WE1	28	H400S22H01
29	H250S76GF1	30	V400S[illegible]GF1	31	V10CS55GE1	32	H10CS65H01
33	V250S3MGF2	34	V250S[illegible]WF1	35	V250S3MWF1	36	V400S4M4E1
37	V400S3MGE1	38	V150S3MGF1	39	H15C064LA1	40	H15C062GE1
41	H15C064GF1	42	H15C055GF1	43	H15C062GE2	44	H400S76CH1
45	H400S76SF1	46	H400S44SF1	47	H400S55WE1	48	H400S625F1
49	H400S65SF1	50	H135L75SF1	51	H90LS75SF1	52	H190L75SE1
53	H250S65WF1	54	H10CS76WI1	55	V180L6WVL1	56	V400S4LAE1
57	H400S67CH1	58	H250S66H01	59	V10CS65H01	60	V250S4LAE1
61	H400S65WE1	62	H15C065SF4	63	V250S3MGE1	64	V180L4SU01
65	V180L4ML01	66	H500S55LA1	67	V180L4MAE1	68	V180L4SU02

INPUT DATA - DEPRECIATION FACTORS

LUMID	DLAMP	DDIRT	OTHER
H15C065GF2	.9500	.8500	1.0000

20-4

LUMINAIRE POSITION AND AIMING DATA

UNIT NO	LUMINAIRE IDCODE	X-COORD	Y-COORD	Z-COORD	HORZ ANGLE	VERT ANGLE
1	HPS	0.00	0.00	40.00	225.00	60.00
2	HPS	0.00	0.00	40.00	15.00	60.00
3	HPS	0.00	0.00	40.00	75.00	60.00
4	HPS	0.00	0.00	40.00	105.00	60.00
5	HPS	0.00	0.00	40.00	165.00	60.00
6	HPS	0.00	0.00	40.00	195.00	60.00
7	HPS	0.00	0.00	40.00	255.00	60.00
8	HPS	0.00	0.00	40.00	285.00	60.00
9	HPS	0.00	0.00	40.00	345.00	60.00
10	HPS	400.00	0.00	40.00	15.00	60.00
11	HPS	400.00	0.00	40.00	75.00	60.00
12	HPS	400.00	0.00	40.00	105.00	60.00
13	HPS	400.00	0.00	40.00	165.00	60.00
14	HPS	400.00	0.00	40.00	195.00	60.00
15	HPS	400.00	0.00	40.00	255.00	60.00
16	HPS	400.00	0.00	40.00	285.00	60.00
17	HPS	400.00	0.00	40.00	345.00	60.00
18	HPS	800.00	0.00	40.00	15.00	60.00
19	HPS	800.00	0.00	40.00	75.00	60.00
20	HPS	800.00	0.00	40.00	105.00	60.00
21	HPS	800.00	0.00	40.00	165.00	60.00
22	HPS	800.00	0.00	40.00	195.00	60.00
23	HPS	800.00	0.00	40.00	255.00	60.00
24	HPS	800.00	0.00	40.00	285.00	60.00
25	HPS	800.00	0.00	40.00	345.00	60.00
26	HPS	1200.00	0.00	40.00	15.00	60.00
27	HPS	1200.00	0.00	40.00	75.00	60.00
28	HPS	1200.00	0.00	40.00	105.00	60.00
29	HPS	1200.00	0.00	40.00	165.00	60.00
30	HPS	1200.00	0.00	40.00	195.00	60.00
31	HPS	1200.00	0.00	40.00	255.00	60.00
32	HPS	1200.00	0.00	40.00	285.00	60.00
33	HPS	1200.00	0.00	40.00	345.00	60.00
34	HPS	1200.00	0.00	40.00	315.00	60.00
35	HPS	0.00	400.00	40.00	15.00	60.00
36	HPS	0.00	400.00	40.00	75.00	60.00
37	HPS	0.00	400.00	40.00	105.00	60.00
38	HPS	0.00	400.00	40.00	165.00	60.00
39	HPS	0.00	400.00	40.00	195.00	60.00
40	HPS	0.00	400.00	40.00	255.00	60.00
41	HPS	0.00	400.00	40.00	285.00	60.00
42	HPS	0.00	400.00	40.00	345.00	60.00
43	HPS	400.00	400.00	40.00	15.00	60.00
44	HPS	400.00	400.00	40.00	75.00	60.00
45	HPS	400.00	400.00	40.00	105.00	60.00

20-5

LUMINAIRE POSITION AND AIMING DATA

UNIT NO	LUMINAIRE IDCODE	X-COORD	Y-COORD	Z-COORD	HORZ ANGLE	VERT ANGLE
46	0P5	400.00	400.00	40.00	165.00	60.00
47	0P5	400.00	400.00	40.00	195.00	60.00
48	0P5	400.00	400.00	40.00	255.00	60.00
49	0P5	400.00	400.00	40.00	285.00	60.00
50	0P5	400.00	400.00	40.00	345.00	60.00
51	0P5	800.00	400.00	40.00	15.00	60.00
52	0P5	800.00	400.00	40.00	75.00	60.00
53	0P5	800.00	400.00	40.00	105.00	60.00
54	0P5	800.00	400.00	40.00	165.00	60.00
55	0P5	800.00	400.00	40.00	195.00	60.00
56	0P5	800.00	400.00	40.00	255.00	60.00
57	0P5	800.00	400.00	40.00	285.00	60.00
58	0P5	800.00	400.00	40.00	345.00	60.00
59	0P5	1200.00	400.00	40.00	15.00	60.00
60	0P5	1200.00	400.00	40.00	75.00	60.00
61	0P5	1200.00	400.00	40.00	105.00	60.00
62	0P5	1200.00	400.00	40.00	165.00	60.00
63	0P5	1200.00	400.00	40.00	195.00	60.00
64	0P5	1200.00	400.00	40.00	255.00	60.00
65	0P5	1200.00	400.00	40.00	285.00	60.00
66	0P5	1200.00	400.00	40.00	345.00	60.00
67	0P5	0.00	800.00	40.00	135.00	60.00
68	0P5	0.00	800.00	40.00	15.00	60.00
69	0P5	0.00	800.00	40.00	75.00	60.00
70	0P5	0.00	800.00	40.00	105.00	60.00
71	0P5	0.00	800.00	40.00	165.00	60.00
72	0P5	0.00	800.00	40.00	195.00	60.00
73	0P5	0.00	800.00	40.00	255.00	60.00
74	0P5	0.00	800.00	40.00	285.00	60.00
75	0P5	0.00	800.00	40.00	345.00	60.00
76	0P5	400.00	800.00	40.00	15.00	60.00
77	0P5	400.00	800.00	40.00	75.00	60.00
78	0P5	400.00	800.00	40.00	105.00	60.00
79	0P5	400.00	800.00	40.00	165.00	60.00
80	0P5	400.00	800.00	40.00	195.00	60.00
81	0P5	400.00	800.00	40.00	255.00	60.00
82	0P5	400.00	800.00	40.00	285.00	60.00
83	0P5	400.00	800.00	40.00	345.00	60.00
84	0P5	800.00	800.00	40.00	15.00	60.00
85	0P5	800.00	800.00	40.00	75.00	60.00
86	0P5	800.00	800.00	40.00	105.00	60.00
87	0P5	800.00	800.00	40.00	165.00	60.00
88	0P5	800.00	800.00	40.00	195.00	60.00
89	0P5	800.00	800.00	40.00	255.00	60.00
90	0P5	800.00	800.00	40.00	285.00	60.00

20-6

LUMINAIRE POSITION AND AIMING DATA

UNIT NO	LUMINAIRE IDCODE	X-COORD	Y-COORD	Z-COORD	HORZ ANGLE	VERT ANGLE
91	005	800.00	800.00	40.00	345.00	60.00
92	005	1200.00	800.00	40.00	15.00	60.00
93	005	1200.00	800.00	40.00	75.00	60.00
94	005	1200.00	800.00	40.00	105.00	60.00
95	005	1200.00	800.00	40.00	165.00	60.00
96	005	1200.00	800.00	40.00	195.00	60.00
97	005	1200.00	800.00	40.00	255.00	60.00
98	005	1200.00	800.00	40.00	285.00	60.00
99	005	1200.00	800.00	40.00	345.00	60.00
100	005	1200.00	800.00	40.00	45.00	60.00

20-7

TE302A   AL:MH(12-POLE) (END ADJ+AL) 8X15000 S400 MH40 - (78/02/17 09.09.08 PAGE 6

CANDLEPOWER TABLE - LUMINAIRE CODE: HISC0653E2 TABLE NO. 12

HORZ. ANGLES (H 18 18)

VERT.									
	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0
	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
-68.0	0	0	69	103	172	241	275	275	334
	334	275	275	241	172	103	69	0	0
-60.0	69	69	103	172	241	275	344	344	413
	413	344	344	275	241	172	103	69	69
-52.0	69	103	172	241	275	344	413	413	447
	447	413	413	344	275	241	172	103	69
-44.0	138	550	1410	2477	3440	3784	4369	4094	4575
	4575	4094	4369	3784	3440	2477	1410	550	138
-36.0	241	963	2236	3440	4541	4850	5538	5263	5814
	5814	5263	5538	4850	4541	3440	2236	963	241
-28.0	413	1376	2993	4782	6020	6536	7396	7086	7878
	7878	7086	7396	6536	6020	4782	2993	1376	413
-20.0	516	1720	4059	6467	8256	9288	10458	10354	11180
	11180	10354	10458	9288	8256	6467	4059	1720	516
-12.0	482	1995	5022	8462	11490	13554	15446	15377	16478
	16478	15377	15446	13554	11490	8462	5022	1995	482
-4.0	585	2546	6605	11627	15962	18954	21844	21741	23323
	23323	21741	21844	18954	15962	11627	6605	2546	585
4.0	516	2408	6605	11352	15755	18886	21810	21913	23667
	23667	21913	21810	18886	15755	11352	6605	2408	516
12.0	516	2167	5470	8944	11937	13966	15962	15962	16994
	16994	15962	15962	13966	11937	8944	5470	2167	516
20.0	447	1720	4094	6605	8566	9598	10870	10733	11455
	11455	10733	10870	9598	8566	6605	4094	1720	447
28.0	378	1410	3096	4919	6192	6777	7774	7465	8153
	8153	7465	7774	6777	6192	4919	3096	1410	378
36.0	241	1032	2167	3574	4644	4988	5745	5401	6054
	6054	5401	5745	4988	4644	3578	2167	1032	241

20-8

153029 ALIMR(12-POLE) (END ADJ+4L) 4X15000 5400 VH40 - (78/02/17 09.09.08 PAGE 7

CANDLEPOWER TABLE - LUMINAIRE CODE: HISCH65GE2 TABLE NO. 12

HORZ. ANGLES (H 1H 1H)

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
44.0	172	550	1479	2546	3612	3853	4472	4162	3990	3990	4162	4472	3853	3612	2546	1479	550	172
52.0	69	103	172	241	275	344	413	413	516	516	413	413	344	275	241	172	103	69
60.0	69	69	103	172	241	275	344	334	447	447	334	344	275	241	172	103	69	69
68.0	0	0	69	103	172	241	275	275	413	413	275	275	241	172	103	69	0	0

20-9

TEST GRID POSITION AND SIZE - TEST GRID 1

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
-400.00	-400.00	3.00	1600.00	1200.00	3.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
11	9	V	270.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 17.5815909544
NUMBER OF POINTS = 99.0000000000

AVERAGE FOOTCANDLES = .1775918278
UNIFORMITY RATIO = 0.0000000000

MAXIMUM FOOTCANDLES = .7162238576
MINIMUM FOOTCANDLES = 0.0000000000

TEST GRID 1 COORDINATES OF CORNER 1 -400.00 -400.00 3.00
COORDINATES OF CORNER 2 1500.00 1200.00 3.00
COORDINATES OF CORNER 3 1600.00 -400.00 3.00
COORDINATES OF CORNER 4 -400.00 1200.00 3.00

	X -400.00	X -200.00	X 0.00	X 200.00	X 400.00	X 600.00	X 800.00	X 1000.00	X 1200.00	Y 1400.00	
Y 1200.00 Z 3.00	.1033	.1783	.2242	.2369	.2407	.2559	.2408	.2387	.2242	.1782	1200.00 Y 3.00 Z
Y 1000.00 Z 3.00	.1134	.3161	.7159	.4354	.6300	.4562	.6298	.4354	.7162	.3160	1000.00 Y 3.00 Z
Y 800.00 Z 3.00	.0701	.1267	.1717	.2099	.2120	.2266	.2120	.2098	.1716	.1265	800.00 Y 3.00 Z
Y 600.00 Z 3.00	.0765	.2182	.5378	.3946	.5996	.4154	.5904	.3986	.5381	.2182	600.00 Y 3.00 Z
Y 400.00 Z 3.00	.0425	.0899	.1270	.1559	.1558	.1677	.1558	.1565	.1270	.0896	400.00 Y 3.00 Z
Y 200.00 Z 3.00	.0409	.1443	.4687	.3132	.5016	.3220	.5016	.3132	.4687	.1643	200.00 Y 3.00 Z
Y 0.00 Z 3.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y 3.00 Z
Y -200.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-200.00 Y 3.00 Z
Y -400.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-400.00 Y 3.00 Z

Full mobile grid - V... 2... ⇓

20-11

TEST GRID 1

COO-DINATES OF CORNER 1	-400.00	-400.00	3.00
COO-DINATES OF CORNER 2	1600.00	1200.00	3.00
COO-DINATES OF CORNER 3	1600.00	-400.00	3.00
COO-DINATES OF CORNER 4	-400.00	1200.00	3.00

	X 1600.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 1200.00 Z 3.00	.1033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 3.00	.1142	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 800.00 Z 3.00	.0700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 600.00 Z 3.00	.0768	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 400.00 Z 3.00	.0425	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 200.00 Z 3.00	.0419	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 0.00 Z 3.00	.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -200.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -400.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

20-12

TEST GRID POSITION AND SIZE - TEST GRID 2

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
-400.00	-400.00	3.00	1200.00	1200.00	3.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
11	9	V	150.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 18.0828381485
NUMBER OF POINTS = 99.0000000000

AVERAGE FOOTCANDLES = .1826564308
UNIFORMITY RATIO = 0.0000000000

MAXIMUM FOOTCANDLES = .7241478165
MINIMUM FOOTCANDLES = 0.0000000000

20-13

TEST GRID 2 COORDINATES OF CORNER 1 -400.00 -400.00 3.00
COORDINATES OF CORNER 2 1600.00 1200.00 3.00
COORDINATES OF CORNER 3 1600.00 -400.00 3.00
COORDINATES OF CORNER 4 -400.00 1200.00 3.00

	X -400.00	X -200.00	X 0.00	X 200.00	X 400.00	X 600.00	X 800.00	X 1000.00	X 1200.00	X 1400.00	
Y 1200.00 Z 3.00	0.0000	0.0000	.0000	.0403	.0415	.0743	.0672	.0947	.0832	.1223	1200.00 Y 3.00 Z
Y 1000.00 Z 3.00	0.0000	0.0000	.0000	.1634	.0883	.2151	.1226	.2400	.1414	.3251	1000.00 Y 3.00 Z
Y 800.00 Z 3.00	0.0000	0.0000	.0000	.4673	.1245	.5332	.1655	.5618	.1065	.7238	800.00 Y 3.00 Z
Y 600.00 Z 3.00	0.0000	0.0000	.0000	.3108	.1526	.3912	.2006	.4235	.2235	.4407	600.00 Y 3.00 Z
Y 400.00 Z 3.00	0.0000	0.0000	.0000	.4969	.1482	.5778	.1974	.6109	.2208	.6282	400.00 Y 3.00 Z
Y 200.00 Z 3.00	0.0000	0.0000	.0000	.3108	.1522	.3912	.2005	.4235	.2235	.4407	200.00 Y 3.00 Z
Y 0.00 Z 3.00	0.0000	0.0000	.0000	.4673	.1245	.5335	.1655	.5622	.1866	.7241	0.00 Y 3.00 Z
Y -200.00 Z 3.00	0.0000	0.0000	.0000	.1634	.0879	.2151	.1225	.2400	.1413	.3252	-200.00 Y 3.00 Z
Y -400.00 Z 3.00	0.0000	0.0000	.0000	.0413	.0415	.0747	.0672	.0950	.0833	.1231	-400.00 Y 3.00 Z

FMG - VFC
180° 1

20-14

TEST GRID 2

COORDINATES OF CORNER 1	-400.00	-400.00	3.00
COORDINATES OF CORNER 2	1600.00	1200.00	3.00
COORDINATES OF CORNER 3	1600.00	-400.00	3.00
COORDINATES OF CORNER 4	-400.00	1200.00	3.00

	X 1600.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 1200.00 Z 3.00	.1040	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 3.00	.1835	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 800.00 Z 3.00	.2274	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 600.00 Z 3.00	.2308	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 400.00 Z 3.00	.2341	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 200.00 Z 3.00	.2386	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 0.00 Z 3.00	.2275	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -200.00 Z 3.00	.1835	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -400.00 Z 3.00	.1041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

20-15

TEST GRID POSITION AND SIZE - TEST GRID 3

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
-400.00	-400.00	.50	1600.00	1200.00	.50

NUMX	NUMYZ	ICOMP	AMETER	XGRID3	YGRID3	ZGRID3
11	9	0	0.00	6.00	0.00	0.00

TOTAL FOOTCANDLES = 29.2449443439
NUMBER OF POINTS = 99.0000000000

AVERAGE FOOTCANDLES = .2953344277
UNIFORMITY RATIO = 39.1663664393

MAXIMUM FOOTCANDLES = 1.9434424333
MINIMUM FOOTCANDLES = .0877396529

20-16

TEST GRID 3 COORDINATES OF CORNER 1 -400.00 -400.00 .50
COORDINATES OF CORNER 2 1600.00 1200.00 .50
COORDINATES OF CORNER 3 1600.00 -400.00 .50
COORDINATES OF CORNER 4 -400.00 1200.00 .50

	X -400.00	X -200.00	X 0.00	X 200.00	X 400.00	X 600.00	X 800.00	X 1000.00	X 1200.00	X 1400.00	
Y 1200.00 Z .50	.0077	.0146	.0186	.0193	.0194	.0207	.0194	.0194	.0186	.0146	1200.00 Y .50 Z
Y 1000.00 Z .50	.0145	.0519	.1310	.0703	.1096	.0728	.1095	.0703	.1311	.0519	1000.00 Y .50 Z
Y 800.00 Z .50	.0184	.1309	1.9484	.1959	1.7465	.1992	1.7465	.1959	1.9484	.1309	800.00 Y .50 Z
Y 600.00 Z .50	.0189	.0698	.1955	.1320	.2101	.1361	.2100	.1320	.1955	.0698	600.00 Y .50 Z
Y 400.00 Z .50	.0184	.1083	1.7452	.2090	1.7593	.2130	1.7593	.2090	1.7452	.1083	400.00 Y .50 Z
Y 200.00 Z .50	.0188	.0698	.1955	.1320	.2100	.1361	.2101	.1320	.1955	.0698	200.00 Y .50 Z
Y 0.00 Z .50	.0184	.1309	1.9484	.1959	1.7465	.1992	1.7465	.1959	1.9484	.1309	0.00 Y .50 Z
Y -200.00 Z .50	.0145	.0519	.1311	.0703	.1095	.0728	.1096	.0703	.1310	.0519	-200.00 Y .50 Z
Y -400.00 Z .50	.0077	.0146	.0186	.0194	.0194	.0207	.0194	.0193	.0186	.0146	-400.00 Y .50 Z

EMG - HFC

20-17

TEST GRID 3 COORDINATES OF CORNER 1 -400.00 -400.00 .50
COORDINATES OF CORNER 2 1600.00 1200.00 .50
COORDINATES OF CORNER 3 1600.00 -400.00 .50
COORDINATES OF CORNER 4 -400.00 1200.00 .50

	X 1600.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 1200.00 Z .50	.0077	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z .50	.0145	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 800.00 Z .50	.0184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 600.00 Z .50	.0188	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 400.00 Z .50	.0184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 200.00 Z .50	.0189	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 0.00 Z .50	.0194	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -200.00 Z .50	.0145	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -400.00 Z .50	.0077	0.0000	0.000[illegible]	[illegible]0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

20-8

TEST GRID POSITION AND SIZE - TEST GRID =

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
-400.00	-400.00	3.00	1600.00	1200.00	3.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
11	9	9	22[illegible].00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 19.1670749227
NUMBER OF POINTS = 99.0000000000

AVERAGE FOOTCANDLES = .1936068578
UNIFORMITY RATIO = 0.0000000000

MAXIMUM FOOTCANDLES = .6064117163
MINIMUM FOOTCANDLES = 0.0000000000

20-19

TEST GRID 4	COORDINATES OF CORNER 1	-400.00	-400.00	3.00
	COORDINATES OF CORNER 2	1600.00	1200.00	3.00
	COORDINATES OF CORNER 3	1600.00	-400.00	3.00
	COORDINATES OF CORNER 4	-400.00	1200.00	3.00

	X -400.00	X -200.00	X 0.00	X 200.00	X 400.00	X 600.00	X 800.00	X 1000.00	X 1200.00	X 1400.00	
Y 1200.00 Z 3.00	.0102	.0544	.1099	.1397	.1574	.1862	.1885	.2065	.2174	.2128	1200.00 Y 3.00 Z
Y 1000.00 Z 3.00	.0107	.0250	.4500	.2788	.4573	.3384	.4941	.3620	.6064	$\boxed{.4534}$	1000.00 Y 3.00 Z
Y 800.00 Z 3.00	.0051	.0360	.0792	.4282	.2000	.4931	.2394	.5181	.2532	.6014	800.00 Y 3.00 Z
Y 600.00 Z 3.00	.0053	.0159	.3330	.2545	.4573	.3255	.4969	.3519	.5100	.3497	600.00 Y 3.00 Z
Y 400.00 Z 3.00	.0000	.0242	.0605	.3999	.1653	.4568	.2000	.4802	.2166	.4682	400.00 Y 3.00 Z
Y 200.00 Z 3.00	0.0000	.0000	.3029	.2118	.3999	.2595	.4283	.2788	.4422	.2893	200.00 Y 3.00 Z
Y 0.00 Z 3.00	0.0000	0.0000	0.0000	.3029	.0605	.3331	.0792	.3469	.0898	.4585	0.00 Y 3.00 Z
Y -200.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	.0242	.0159	.0361	.0250	.0437	.0315	-200.00 Y 3.00 Z
Y -400.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	.0055	.0053	.0109	.0103	.0154	-400.00 Y 3.00 Z

20-20

TEST GRID 4 COO-DINATES OF CORNER 1 -400.00 -400.00 3.00
COO-DINATES OF CORNER 2 1600.00 1200.00 3.00
COO-DINATES OF CORNER 3 1600.00 -400.00 3.00
COO-DINATES OF CORNER 4 -400.00 1200.00 3.00

	X 1600.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 1200.00 Z 3.00	.1501	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 3.00	.2105	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 800.00 Z 3.00	.2103	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 600.00 Z 3.00	.1928	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 400.00 Z 3.00	.1655	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 200.00 Z 3.00	.1496	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 0.00 Z 3.00	.1167	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -200.00 Z 3.00	.0599	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -400.00 Z 3.00	.0143	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

20-21

TEST GRID POSITION AND SIZE - TEST GRID 5

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
375.00	380.00	3.00	700.00	640.00	3.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
14	14	V	270.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 187.6641427985
NUMBER OF POINTS = 196.0000000000

AVERAGE FOOTCANDLES = .9574701163
UNIFORMITY RATIO = 6.1454426116

MAXIMUM FOOTCANDLES = 6.7975445889
MINIMUM FOOTCANDLES = .1558016528

20-22

TF302M ALIMR(12-POLE) (END ADJ+4L) RX15000 S400 MH40 - 1 78/02/17 09.09.08 PAGE 21

TEST GRID 5

COORDINATES OF CORNER 1	375.00	380.00	3.00
COORDINATES OF CORNER 2	700.00	640.00	3.00
COORDINATES OF CORNER 3	700.00	390.00	3.00
COORDINATES OF CORNER 4	375.00	640.00	3.00

	X 375.00	X 400.00	X 425.00	X 450.00	X 475.00	X 500.00	X 525.00	X 550.00	X 575.00	X 600.00	
Y 640.00 Z 3.00	.4341	.4394	.4426	.4418	.4350	.4233	.4045	.3923	.3794	.3768	640.00 Y 3.00 Z
Y 620.00 Z 3.00	.5045	.5015	.5073	.5040	.4454	.4703	.4513	.4230	.4031	.3960	620.00 Y 3.00 Z
Y 600.00 Z 3.00	.5994	$\boxed{.5906}$ UCL	.6012	.5845	.5691	.5268	.4939	.4556	.4280	$\boxed{.4154}$ UM	600.00 Y 3.00 Z
Y 580.00 Z 3.00	.7313	.7207	.7342	.7133	.6645	.6062	.5406	.4868	.4511	.4423	580.00 Y 3.00 Z
Y 560.00 Z 3.00	.9259	.9109	.9284	.8913	.7499	.6925	.5967	.5154	.4771	.4691	560.00 Y 3.00 Z
Y 540.00 Z 3.00	1.2220	1.2033	1.2246	1.1497	.9743	.8023	.6474	.5478	.5034	.4824	540.00 Y 3.00 Z
Y 520.00 Z 3.00	1.7127	1.7107	1.7120	1.5563	1.2198	.9229	.7076	.5810	.5052	.4911	520.00 Y 3.00 Z
Y 500.00 Z 3.00	2.5764	2.6392	2.5754	2.1640	1.5572	1.0554	.7642	.5832	.5013	.4735	500.00 Y 3.00 Z
Y 480.00 Z 3.00	4.0406	4.4092	4.0442	3.0307	1.8890	1.1862	.7805	.5670	.4737	.4457	480.00 Y 3.00 Z
Y 460.00 Z 3.00	5.7335	6.6269	5.7370	3.8886	2.2275	1.2310	.7353	.5195	.4218	.3922	460.00 Y 3.00 Z
Y 440.00 Z 3.00	5.9569	6.7075	5.9605	4.1240	2.1137	1.0534	.6091	0.47 (0.4)* .4257	.3457	.3240	440.00 Y 3.00 Z
Y 420.00 Z 3.00	3.8788	3.2266	3.8826	2.7222	1.3745	.6591	.3998	.3011	.2585	.2466	420.00 Y 3.00 Z
Y 400.00 Z 3.00	.1561	.1558	.1599	.1622	.1653	.1661	.1676	.1690	.1688	$\boxed{.1677}$ LM	400.00 Y 3.00 Z
Y 380.00 Z 3.00	.1683	.1684	.1723	.1746	.1776	.1784	.1793	.1806	.1805	.1797	380.00 Y 3.00 Z

Test Grid Limits

1.0 PC

FC

Grid "A"

* Vsl corresponding to 5% voltage dr. in supply circuit to lamp

20-21

TEST GRID 5 COORDINATES OF CORNER 1 375.00 380.00 3.00
COORDINATES OF CORNER 2 700.00 640.00 3.00
COORDINATES OF CORNER 3 700.00 380.00 3.00
COORDINATES OF CORNER 4 375.00 640.00 3.00

	X 625.00	X 650.00	X 675.00	X 700.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 640.00 Z 3.00	.3794	.3463	.4045	.4233	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 620.00 Z 3.00	.4031	.4186	.4451	.4685	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 600.00 Z 3.00	.4280	.4556	.4849	.5251	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 580.00 Z 3.00	.4511	.4945	.5310	.5969	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 560.00 Z 3.00	.4742	.5140	.5948	.6819	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 540.00 Z 3.00	.5005	.5478	.6474	.8023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 520.00 Z 3.00	.5109	.5810	.7076	.9226	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 500.00 Z 3.00	.5058	.5908	.7640	1.0562	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 480.00 Z 3.00	.4737	.5731	.7601	1.1870	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 460.00 Z 3.00	.4215	.5142	.7431	1.2319	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 440.00 Z 3.00	.3454	.4254	.6102	1.0575	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 420.00 Z 3.00	.2586	.3018	.3996	.6593	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 400.00 Z 3.00	.1688	.1707	.1691	.1661	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 380.00 Z 3.00	.1823	.1427	.1613	.1784	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

20-24

TEST GRID POSITION AND SIZE - TEST GRID 6

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
400.00	400.00	3.00	600.00	600.00	3.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
9	11	V	270.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 120.4654446126
NUMBER OF POINTS = 99.0000000000

VFC
③ 270° ⇓

$\boxed{\begin{array}{l}\text{AVERAGE FOOTCANDLES = 1.2168226729} \\ \text{UNIFORMITY RATIO = 7.8100755074}\end{array}}$

MAXIMUM FOOTCANDLES = 6.7975445869
MINIMUM FOOTCANDLES = .1558016528

Note: Uniformity would be much lower if both the 270° grid and the 180° grid (G7) were considered together.

TE3029 ALIMH(12-POLE) (END ADJ+4L) 8X15000 5400 MH40 - 4 78/02/17 09.09.08 PAGE 24

TEST GRID 6 COORDINATES OF CORNER 1 400.00 400.00 3.00
COO-DINATES OF CORNER 2 600.00 600.00 3.00
COO-DINATES OF CORNER 3 600.00 400.00 3.00
COO-DINATES OF CORNER 4 400.00 600.00 3.00

	X 400.00	X 425.00	X 450.00	X 475.00	X 500.00	X 525.00	X 550.00	X 575.00	X 600.00	X 0.00	
Y 600.00 Z 3.00	.5906	.6012	.5845	.5691	.5268	.4939	.4556	.4280	.4154	0.0000	0.00 Y 0.00 Z
Y 580.00 Z 3.00	.7247	.7342	.7133	.6645	.6062	.5406	.4868	.4511	.4423	0.0000	0.00 Y 0.00 Z
Y 560.00 Z 3.00	.9169	.9284	.8913	.7899	.6925	.5967	.5164	.4771	.4691	0.0000	0.00 Y 0.00 Z
Y 540.00 Z 3.00	1.2033	1.2246	1.1497	.9743	.8023	.6474	.5478	.5034	.4828	0.0000	0.00 Y 0.00 Z
Y 520.00 Z 3.00	1.7107	1.7120	1.5563	1.2198	.9229	.7076	.5810	.5052	.4911	0.0000	0.00 Y 0.00 Z
Y 500.00 Z 3.00	2.6392	2.5754	2.1640	1.5572	1.0554	.7642	.5832	.5013	.4735	0.0000	0.00 Y 0.00 Z
Y 480.00 Z 3.00	4.4092	4.0442	3.0307	1.8890	1.1862	.7805	.5670	.4737	.4457	0.0000	0.00 Y 0.00 Z
Y 460.00 Z 3.00	6.6269	5.7370	3.8886	2.2275	1.2310	.7353	.5195	.4218	.3922	0.0000	0.00 Y 0.00 Z
Y 440.00 Z 3.00	6.7975	5.9605	4.1249	2.1137	1.0534	.6091	.4257	.3457	.3240	0.0000	0.00 Y 0.00 Z
Y 420.00 Z 3.00	3.2266	3.8826	2.7222	1.3765	.6591	.3998	.3011	.2585	.2466	0.0000	0.00 Y 0.00 Z
Y 400.00 Z 3.00	[illegible]	.1594	.1622	.1653	.1661	.1676	.1690	.1688	.1677	0.0000	0.00 Y 0.00 Z

TEST GRID - VIEW 270°

20-26

TEST GRID POSITION AND SIZE - TEST GRID 7

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
375.00	340.00	3.00	700.00	640.00	3.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
14	14	V	140.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 168,0803948493
NUMBER OF POINTS = 196.0000000000

AVERAGE FOOTCANDLES = .8575530349
UNIFORMITY RATIO = 5.7850464038

MAXIMUM FOOTCANDLES = 7.1562211739
MINIMUM FOOTCANDLES = .1482361549

20-27

TE302A ALTHR(12-POLE) (END ADJ+4L) AX15000 S400 M..0 - 1 78/02/17 09.09.09 PAGE 2

TEST GRID 7

COORDINATES OF CORNER 1	375.00	380.00	3.00
COORDINATES OF CORNER 2	700.00	640.00	3.00
COORDINATES OF CORNER 3	700.00	380.00	3.00
COORDINATES OF CORNER 4	375.00	640.00	3.00

	X 375.00	X 400.00	X 425.00	X 450.00	X 475.00	X 500.00	X 525.00	X 550.00	X 575.00	X 600.00	
Y 640.00 Z 3.00	.1659	.1518	.2879	.4109	.4876	.5191	.5186	.4850	.4400	.4151	640.00 Y 3.00 Z
Y 620.00 Z 3.00	.1672	.1523	.2552	.3566	.4323	.4691	.4777	.4620	.4204	.3978	620.00 Y 3.00 Z
Y 600.00 Z 3.00	.1680	.1526	.2502	.3403	.4156	.4529	.4600	.4567	.4260	.3917	600.00 Y 3.00 Z
Y 580.00 Z 3.00	.1694	.1545	.2604	.3592	.4351	.4763	.4826	.4624	.4320	.4016	580.00 Y 3.00 Z
Y 560.00 Z 3.00	.1726	.1578	.2425	.4160	.4932	.5315	.5246	.4889	.4540	.4226	560.00 Y 3.00 Z
Y 540.00 Z 3.00	.1736	.1581	.3569	.5240	.6149	.6344	.5945	.5419	.4961	.4434	540.00 Y 3.00 Z
Y 520.00 Z 3.00	.1727	.1572	.4848	.7477	.8270	.7939	.7089	.6271	.5395	.4759	520.00 Y 3.00 Z
Y 500.00 Z 3.00	.1714	.1555	.7615	1.1616	1.2043	1.0418	.8775	.7130	.6010	.5077	500.00 Y 3.00 Z
Y 480.00 Z 3.00	.1712	.1557	1.3689	1.9493	1.7708	1.4199	1.0809	.8241	.6612	.5440	480.00 Y 3.00 Z
Y 460.00 Z 3.00	.1703	.1543	2.4766	3.2575	2.7283	1.9139	1.2980	.9450	.7193	.5664	460.06 Y 3.00 Z
Y 440.00 Z 3.00	.1656	.1503	3.7748	5.1019	3.8020	2.3541	1.4917	1.0249	.7447	.5811	440.00 Y 3.00 Z
Y 420.00 Z 3.00	.1643	.1480	4.8017	[illegible]	4.6667	2.6041	1.5627	1.0519	.7611	.5847	420.00 Y 3.00 Z
Y 400.00 Z 3.00	.1644	.1462	4.2267	7.1562	4.8964	2.6284	1.5482	1.0293	.7490	.5778	400.00 Y 3.00 Z
Y 380.00 Z 3.00	.1673	.1512	4.4040	6.5510	4.6685	2.6013	1.5574	1.0526	.7623	.5850	380.00 Y 3.00 Z

0.47 FC

1.0 FC

Grid "A" - VFC, 180° ←

20-28

TEST GRID 7

COORDINATES OF CORNER 1	375.00	380.00	3.00
COORDINATES OF CORNER 2	700.00	640.00	3.00
COORDINATES OF CORNER 3	700.00	380.00	3.00
COORDINATES OF CORNER 4	375.00	640.00	3.00

		X	X	X	X	X	X	X	X	X	X	
		625.00	650.00	675.00	700.00	0.00	0.00	0.00	0.00	0.00	0.00	
Y	640.00	.3772	.3438	.3147	.2836	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	620.00	.3679	.3401	.3137	.2850	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	600.00	.3663	.3412	.31[illegible]6	.2858	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	580.00	.3717	.3405	.3144	.2884	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	560.00	.3806	.3477	.3188	.2909	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	540.00	.3999	.3586	.3225	.2942	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	520.00	.4195	.3703	.3304	.2944	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	500.00	.4398	.3645	.3388	.3019	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	480.00	.4580	.3928	.3414	.3016	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	460.00	.4642	.3936	.3453	.3049	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	440.00	.4731	.3997	.3467	.3045	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	420.00	.4719	.3924	.3393	.2993	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	400.00	.4709	.3996	.3453	.3030	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	380.00	.4739	.4000	.3458	.3934	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z

70-27

TEST GRID POSITION AND SIZE - TEST GRID H

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
375.00	380.00	.50	700.00	640.00	.50

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
14	14	H	0.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 166.3789319426
NUMBER OF POINTS = 196.0000000000

AVERAGE FOOTCANDLES = .0484721015
UNIFORMITY RATIO = 6.2371430697

MAXIMUM FOOTCANDLES = 6.2340372838
MINIMUM FOOTCANDLES = .1366996073

20-31

TEST GRID B

COORDINATES OF CORNER 1	375.00	380.00	.50
COORDINATES OF CORNER 2	700.00	640.00	.50
COORDINATES OF CORNER 3	700.00	380.00	.50
COORDINATES OF CORNER 4	375.00	640.00	.50

	X 375.00	X 400.00	X 425.00	X 450.00	X 475.00	X 500.00	X 525.00	X 550.00	X 575.00	X 600.00	
Y 640.00 Z .50	.2761	.2721	.2767	.2675	.2404	.2098	.1845	.1618	.1489	.1467	640.00 Y .50 Z
Y 620.00 Z .50	.2275	.2238	.2280	.2225	.2092	.1888	.1719	.1543	.1427	.1389	620.00 Y .50 Z
Y 600.00 Z .50	.2136	.2101	.2140	.2091	.1991	.1818	.1667	.1529	.1413	.1361	600.00 Y .50 Z
Y 580.00 Z .50	.2285	.2248	.2290	.2233	.2100	.1918	.1722	.1551	.1438	.1400	580.00 Y .50 Z
Y 560.00 Z .50	.2783	.2740	.2786	.2693	.2425	.2140	.1870	.1638	.1518	.1489	560.00 Y .50 Z
Y 540.00 Z .50	.3816	.3754	.3821	.3612	.3102	.2583	.2106	.1796	.1651	.1582	540.00 Y .50 Z
Y 520.00 Z .50	.5927	.5956	.5916	.5401	.4284	.3238	.2499	.2046	.1793	.1716	520.00 Y .50 Z
Y 500.00 Z .50	1.0415	1.0719	1.0400	.8773	.6304	.4236	.3057	.2332	.1955	.1837	500.00 Y .50 Z
Y 480.00 Z .50	1.9601	2.1161	1.9602	1.4844	.9351	.5780	.3744	.2619	.2132	.1989	480.00 Y .50 Z
Y 460.00 Z .50	3.4661	4.0543	3.4663	2.4269	1.4307	.7889	.4464	.2958	.2289	.2093	460.00 Y .50 Z
Y 440.00 Z .50	4.9917	5.5934	4.9921	3.7012	1.9875	.9603	.5064	.3177	.2371	.2152	440.00 Y .50 Z
Y 420.00 Z .50	6.2336	5.0105	6.2340	4.4954	2.3808	1.0606	.5285	.3267	.2398	.2163	420.00 Y .50 Z
Y 400.00 Z .50	5.1771	1.7593	5.1775	4.8839	2.4747	1.0729	.5257	.3180	.2357	.2130	400.00 Y .50 Z
Y 380.00 Z .50	6.2336	5.0194	6.2340	4.4952	2.3805	1.0585	.5259	.3237	.2397	.2163	380.00 Y .50 Z

Grid "A" UFC

20-B

TEST GRID B

COORDINATES OF CORNER 1	375.00	380.00	.50
COORDINATES OF CORNER 2	700.00	640.00	.50
COORDINATES OF CORNER 3	700.00	380.00	.50
COORDINATES OF CORNER 4	375.00	640.00	.50

Y / Z	X 625.00	X 650.00	X 675.00	X 700.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 640.00 Z .50	.1496	.1617	.1850	.2119	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 620.00 Z .50	.1427	.1541	.1712	.1908	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 600.00 Z .50	.1413	.1529	.1667	.1818	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 580.00 Z .50	.1438	.1554	.1729	.1898	C.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 560.00 Z .50	.1510	.1639	.1865	.2118	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 540.00 Z .50	.1646	.1803	.2106	.2543	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 520.00 Z .50	.1747	.2046	.2499	.3238	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 500.00 Z .50	.1976	.2332	.3057	.4236	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 480.00 Z .50	.2129	.2650	.3743	.5780	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 460.00 Z .50	.2286	.2955	.4509	.7889	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 440.00 Z .50	.2368	.3174	.5074	.9633	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 420.00 Z .50	.2397	.3237	.5259	1.0585	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 400.00 Z .50	.2357	.3180	.5257	1.0729	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 380.00 Z .50	.2398	.3267	.5285	1.0606	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

20-32

TEST GRID POSITION AND SIZE - TEST GRID 4

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
400.00	780.00	3.00	625.00	1320.00	3.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
10	28	V	270.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 180.6067054014
NUMBER OF POINTS = 280.0000000000

AVERAGE FOOTCANDLES = .6450239479
UNIFORMITY RATIO = 3.6112047055

MAXIMUM FOOTCANDLES = 6.8495731643
MINIMUM FOOTCANDLES = .1786173868

TEST GRID 9 COORDINATES OF CORNER 1 400.00 780.00 3.00
COORDINATES OF CORNER 2 525.00 1320.00 3.00
COORDINATES OF CORNER 3 625.00 780.00 3.00
COORDINATES OF CORNER 4 400.00 1320.00 3.00

	X 400.00	X 425.00	X 450.00	X 475.00	X 500.00	X 525.00	X 550.00	X 575.00	X 600.00	X 625.00	
Y 1320.00 Z 3.00	.1786	.1809	.1827	.1839	.1852	.1853	.1865	.1883	.1890	.1882	1320.00 Y 3.00 Z
Y 1300.00 Z 3.00	.1871	.1900	.1913	.1929	.1944	.1948	.1962	.1978	.1983	.1978	1300.00 Y 3.00 Z
Y 1280.00 Z 3.00	.1959	.1993	.2003	.2026	.2044	.2053	.2066	.2079	.2082	.2079	1280.00 Y 3.00 Z
Y 1260.00 Z 3.00	.2055	.2091	.2113	.2133	.2152	.2169	.2185	.2188	.2188	.2185	1260.00 Y 3.00 Z
Y 1240.00 Z 3.00	.2160	.2199	.2224	.2248	.2269	.2291	.2311	.2305	.2299	.2302	1240.00 Y 3.00 Z
Y 1220.00 Z 3.00	.2276	.2320	.2351	.2386	.2396	.2423	.2443	.2433	.2426	.2431	1220.00 Y 3.00 Z
Y 1200.00 Z 3.00	.2407	.2461	.2491	.2529	.2545	.2564	.2580	.2575	.2559	.2573	1200.00 Y 3.00 Z
Y 1180.00 Z 3.00	.2565	.2618	.2647	.2687	.2701	.2714	.2730	.2726	.2716	.2741	1180.00 Y 3.00 Z
Y 1160.00 Z 3.00	.2747	.2801	.2824	.2857	.2871	.2903	.2891	.2882	.2885	.2906	1160.00 Y 3.00 Z
Y 1140.00 Z 3.00	.2954	.3010	.3033	.3044	.3067	.3093	.3061	.3055	.3087	.3076	1140.00 Y 3.00 Z
Y 1120.00 Z 3.00	.3230	.3253	.3271	.3268	.3289	.3299	.3274	.3251	.3273	.3273	1120.00 Y 3.00 Z
Y 1100.00 Z 3.00	.3506	.3537	.3557	.3538	.3546	.3520	.3484	.3502	.3473	.3474	1100.00 Y 3.00 Z
Y 1080.00 Z 3.00	.3847	.3871	.3894	.3865	.3851	.3769	.3718	.3724	.3680	.3695	1080.00 Y 3.00 Z
Y 1060.00 Z 3.00	.4258	.4277	.4298	.4255	.4283	.4068	.4014	.3949	.3923	.3917	1060.00 Y 3.00 Z
Y 1040.00 Z 3.00	.4764	.4798	.4792	.4726	.4609	.4421	.4301	.4174	.4149	.4174	1040.00 Y 3.00 Z
Y 1020.00 Z 3.00	.5396	.5459	.5426	.5342	.5092	.4902	.4621	.4424	.4354	.4426	1020.00 Y 3.00 Z

Grid "B" VFC 270°

20.34

TEST GRID 9 COORDINATES OF CORNER 1 400.00 780.00 3.00
COORDINATES OF CORNER 2 625.00 1320.00 3.00
COORDINATES OF CORNER 3 625.00 780.00 3.00
COORDINATES OF CORNER 4 400.00 1320.00 3.00

	X 400.00	X 425.00	X 450.00	X 475.00	X 500.00	X 525.00	X 550.00	X 575.00	X 600.00	X 625.00	
Y 1000.00 Z 3.00	.6100	.6441	.6281	.6092	.5671	.5342	.4961	.4687	.4562	.4689	1000.00 Y 3.00 Z
Y 980.00 Z 3.00	.7613	.7754	.7547	.7060	.6478	.5824	.5288	.4932	.4847	.4934	980.00 Y 3.00 Z
Y 960.00 Z 3.00	.9529	.9711	.9342	.8331	.7356	.6400	.5598	.5207	.5131	.5181	960.00 Y 3.00 Z
Y 940.00 Z 3.00	1.2468	1.2687	1.1941	1.0191	.8469	.6923	.5928	.5488	.5281	.5466	940.00 Y 3.00 Z
Y 920.00 Z 3.00	1.7557	1.7578	1.6024	1.2662	.9695	.7541	.6278	.5523	.5382	.5580	920.00 Y 3.00 Z
Y 900.00 Z 3.00	2.6858	2.6227	2.2117	1.6054	1.1038	.8126	.6320	.5502	.5223	.5547	900.00 Y 3.00 Z
Y 880.00 Z 3.00	4.4575	4.0933	3.0801	1.9391	1.2365	.8309	.6176	.5244	.4964	.5244	880.00 Y 3.00 Z
Y 860.00 Z 3.00	6.6771	5.7879	3.9399	2.2795	1.2833	.7881	.5723	.4744	.4448	.4741	860.00 Y 3.00 Z
Y 840.00 Z 3.00	6.8496	6.0134	4.1774	2.1678	1.1077	.6640	.4806	.4004	.3786	.4000	840.00 Y 3.00 Z
Y 820.00 Z 3.00	3.2806	3.9375	2.7777	1.4267	.7159	.4569	.3583	.3156	.3033	.3154	820.00 Y 3.00 Z
Y 800.00 Z 3.00	.2120	.2170	.2200	.2237	.2252	.2271	.2286	.2281	.2266	.2279	800.00 Y 3.00 Z
Y 780.00 Z 3.00	.2269	.2318	.2347	.2386	.2399	.2412	.2427	.2423	.2413	.2439	780.00 Y 3.00 Z

20-35

TEST GRID POSITION AND SIZE - TEST GRID 10

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
400.00	1000.00	0.00	600.00	1000.00	120.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
9	13	V	270.00	600.00	1000.00	0.00

TOTAL FOOTCANDLES = 41.6399675166
NUMBER OF POINTS = 117.0000000000

AVERAGE FOOTCANDLES = .3558971583
UNIFORMITY RATIO = 2.5506842609

MAXIMUM FOOTCANDLES = .6617005066
MINIMUM FOOTCANDLES = .1395298531

20-26

TEST GRID 10 COORDINATES OF CORNER 1 400.00 1000.00 0.00
COORDINATES OF CORNER 2 600.00 1000.00 120.00
COORDINATES OF CORNER 3 600.00 1000.00 0.00
COORDINATES OF CORNER 4 400.00 1000.00 120.00

	X 400.00	X 425.00	X 450.00	X 475.00	X 500.00	X 525.00	X 550.00	X 575.00	X 600.00	X 0.00	
Y 1000.00 Z 120.00	.1395	.1423	.1474	.1504	.1525	.1546	.1538	.1587	.1602	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 110.00	.1801	.1804	.1779	.1759	.1757	.1786	.1873	.1901	.1905	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 100.00	.2332	.2321	.2241	.2179	.2117	.2173	.2221	.2210	.2204	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 90.00	.2919	.2893	.2734	.2618	.2569	.2568	.2550	.2452	.2406	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 80.00	.3279	.3266	.3113	.3071	.2970	.2905	.2798	.2680	.2623	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 70.00	.3571	.3578	.3475	.3433	.3256	.3150	.3019	.2894	.2832	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 60.00	.3855	.3917	.3845	.3767	.3545	.3424	.3258	.3132	.3070	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 50.00	.4256	.4318	.4259	.4144	.3891	.3747	.3536	.3395	.3324	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 40.00	.4643	.4715	.4641	.4525	.4243	.4077	.3826	.3656	.3569	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 30.00	.4838	.4954	.4888	.4772	.4454	.4258	.3980	.3800	.3701	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 20.00	.5346	.5468	.5387	.5261	.4898	.4658	.4343	.4130	.4015	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 10.00	.5940	.5981	.5869	.5734	.5345	.5046	.4699	.4460	.4336	0.0000	0.00 Y 0.00 Z
Y 1000.00 Z 0.00	.6496	.6617	.6499	.6268	.5617	.5462	.5079	.4789	.4659	0.0000	0.00 Y 0.00 Z

Vertical Grid @ Y = 1000 ft; VFC @ 270° ↓
(parallel to plane of "x"—"z" coordinates)

TEST GRID POSITION AND SIZE - TEST GRID 11

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
600.00	780.00	0.00	600.00	1040.00	120.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
14	13	V	0.00	600.00	1040.00	0.00

TOTAL FOOTCANDLES = 41.5464864100
NUMBER OF POINTS = 182.0000000000

AVERAGE FOOTCANDLES = .2282773979
UNIFORMITY RATIO = 3.3902341243

MAXIMUM FOOTCANDLES = .5665816257
MINIMUM FOOTCANDLES = .0673338152

TEST GRID 11

COORDINATES OF CORNER 1	600.00	780.00	0.00
COORDINATES OF CORNER 2	600.00	1040.00	120.00
COORDINATES OF CORNER 3	600.00	1040.00	0.00
COORDINATES OF CORNER 4	600.00	780.00	120.00

	(780y) X	(800y) X	X	(840y) X	X	(880y) X	X	(920y) X	X	(960y) X	
	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	
Y 780.00 Z 120.00	.0804	.0772	.0754	.0766	.0766	.0752	.0734	.0717	.0693	.0685	960.00 Y 120.00 Z
Y 780.00 Z 110.00	.1174	.1150	.1118	.1055	.0995	.0936	.0907	.0876	.0492	.0898	960.00 Y 110.00 Z
Y 780.00 Z 100.00	.1677	.1654	.1617	.1586	.1403	.1305	.1197	.1186	.1176	.1131	960.00 Y 100.00 Z
Y 780.00 Z 90.00	.2237	.2214	.2171	.1994	.1837	.1707	.1601	.1534	.1462	.1346	960.00 Y 90.00 Z
Y 780.00 Z 80.00	.2580	.2544	.2510	.2343	.2203	.2107	.1949	.1831	.1680	.1498	960.00 Y 80.00 Z
Y 780.00 Z 70.00	.2856	.2804	.2780	.2653	.2530	.2402	.2182	.2022	.1851	.1642	960.00 Y 70.00 Z
Y 780.00 Z 60.00	.3123	.3055	.3074	.2981	.2845	.2668	.2409	.2238	.2026	.1789	960.00 Y 60.00 Z
Y 780.00 Z 50.00	.3486	.3424	.3446	.3346	.3188	.2979	.2690	.2464	.2233	.1965	960.00 Y 50.00 Z
Y 780.00 Z 40.00	.3838	.3779	.3818	.3702	.3528	.3303	.2982	.2718	.2459	.2145	960.00 Y 40.00 Z
Y 780.00 Z 30.00	.4041	.3976	.4026	.3954	.3775	.3536	.3181	.2884	.2592	.2261	960.00 Y 30.00 Z
Y 780.00 Z 20.00	.4510	.4448	.4506	.4418	.4222	.3956	.3554	.3266	.2867	.2490	960.00 Y 20.00 Z
Y 780.00 Z 10.00	.5069	.5004	.4954	.4860	.4653	.4360	.3923	.3575	.3124	.2716	960.00 Y 10.00 Z
Y 780.00 Z 0.00	.5666	.5516	.5543	.5436	.5190	.4820	.4321	.3917	.3395	.2954	960.00 Y 0.00 Z

Vertical Grid @ X = 600 ft ; VFC @ 0° ⟹
(parallel to plane of "y" "z" coordinates)

TEST GRID 11 COORDINATES OF CORNER 1 600.00 780.00 0.00
COORDINATES OF CORNER 2 600.00 1040.00 120.00
COORDINATES OF CORNER 3 600.00 1040.00 0.00
COORDINATES OF CORNER 4 600.00 780.00 120.00

	(980y) X	(1000y) X	X	(1040y) X	X	X	X	X	X	X	
	600.00	600.00	600.00	600.00	0.00	0.00	0.00	0.00	0.00	0.00	
Y 980.00 Z 120.00	.0701	.0699	.0690	.0673	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 980.00 Z 110.00	.0878	.0848	.0817	.0786	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 940.00 Z 100.00	.1065	.0995	.0930	.0677	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 980.00 Z 90.00	.1194	.1093	.1017	.0952	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 980.00 Z 80.00	.1329	.1199	.1109	.1029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 980.00 Z 70.00	.1451	.1301	.1193	.1099	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 980.00 Z 60.00	.1584	.1417	.1293	.1184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 980.00 Z 50.00	.1733	.1541	.1398	.1273	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 940.00 Z 40.00	.1881	.1661	.1502	.1363	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 980.00 Z 30.00	.1971	.1728	.1556	.1405	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 980.00 Z 20.00	.2160	.1883	.1688	.1517	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 940.00 Z 10.00	.2348	.2041	.1821	.1631	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 940.00 Z 0.00	.2532	.2199	.1952	.1742	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

20-45

TEST GRID POSITION AND SIZE - TEST GRID 12

XGRID1	YGRID1	ZGRID1	XGRID2	YGRID2	ZGRID2
1100.00	760.00	3.00	1575.00	1040.00	3.00

NUMX	NUMYZ	ICOMP	HMETER	XGRID3	YGRID3	ZGRID3
20	14	V	270.00	0.00	0.00	0.00

TOTAL FOOTCANDLES = 258.1510064435
NUMBER OF POINTS = 280.0000000000

AVERAGE FOOTCANDLES = .9219674732
UNIFORMITY RATIO = 12.1637864559

MAXIMUM FOOTCANDLES = 8.6652705842
MINIMUM FOOTCANDLES = .0757941121

20-41

TF302H ALINR(12-POLE) (END ADJ+4L) 8X15000 5400 MP40 - (78/02/17 09.09.08 PAGE 40

TEST GRID 12	COORDINATES OF CORNER 1	1100.00	780.00	3.00
	COORDINATES OF CORNER 2	1575.00	1040.00	3.00
	COORDINATES OF CORNER 3	1575.00	780.00	3.00
	COORDINATES OF CORNER 4	1100.00	1040.00	3.00

	X 1100.00	X 1125.00	X 1150.00	X 1175.00	X 1200.00	X 1225.00	X 1250.00	X 1275.00	X 1300.00	X 1325.00	
Y 1040.00 Z 3.00	.4339	.4515	.4734	.4917	.5100	.5177	.5095	.4880	.4572	.4118	1040.00 Y 3.00 Z
Y 1020.00 Z 3.00	.4784	.5137	.5412	.5745	.5957	.6105	.5972	.5694	.5218	.4666	1020.00 Y 3.00 Z
Y 1000.00 Z 3.00	.5371	.5900	.6341	.6867	.7162	.7427	.7191	.6747	.5973	.5206	1000.00 Y 3.00 Z
Y 980.00 Z 3.00	.6119	.6880	.7678	.8449	.8906	.9313	.8958	.8156	.7030	.5846	980.00 Y 3.00 Z
Y 960.00 Z 3.00	.6984	.8104	.9528	1.0776	1.1469	1.2054	1.1484	1.0005	.8254	.6659	960.00 Y 3.00 Z
Y 940.00 Z 3.00	.8126	.9794	1.2166	1.4312	1.5546	1.6246	1.5174	1.2541	.9847	.7506	940.00 Y 3.00 Z
Y 920.00 Z 3.00	.9356	1.2447	1.6162	1.9865	2.2567	2.3261	2.0939	1.5905	1.1694	.8401	920.00 Y 3.00 Z
Y 900.00 Z 3.00	1.0719	1.5778	2.2127	2.9174	3.4911	3.5677	2.9469	2.0651	1.3656	.9210	900.00 Y 3.00 Z
Y 880.00 Z 3.00	1.2054	1.9070	3.0813	4.3863	5.7063	5.7107	4.1567	2.5643	1.5459	.9471	880.00 Y 3.00 Z
Y 860.00 Z 3.00	1.2532	2.2458	3.9121	6.0782	3.2322	8.2575	5.5759	3.0394	1.5993	.9081	860.00 Y 3.00 Z
Y 840.00 Z 3.00	1.0817	2.1353	4.1383	6.2198	4.4083	8.6853	5.9647	2.9283	1.3925	.7399	840.00 Y 3.00 Z
Y 820.00 Z 3.00	.6871	1.3942	2.7420	3.9172	4.3390	5.4495	3.8542	1.6499	.8434	.4606	820.00 Y 3.00 Z
Y 800.00 Z 3.00	.1973	.1926	.1657	.1771	.1716	.1702	.1659	.1621	.1560	.1507	800.00 Y 3.00 Z
Y 780.00 Z 3.00	.2111	.2060	.1990	.1898	.1846	.1834	.1789	.1746	.1672	.1611	780.00 Y 3.00 Z

Grid "C" V+C @ 270°

20-42

TEST GRID 12

COORDINATES OF CORNER 1	1100.00	780.00	3.00
COORDINATES OF CORNER 2	1575.00	1040.00	3.00
COORDINATES OF CORNER 3	1575.00	780.00	3.00
COORDINATES OF CORNER 4	1100.00	1040.00	3.00

	X 1350.00	X 1375.00	X 1400.00	X 1425.00	X 1450.00	X 1475.00	X 1500.00	X 1525.00	X 1550.00	X 1575.00	
Y 1040.00 Z 3.00	.3687	.3245	.2661	.2498	.2242	.1967	.1754	.1564	.1400	.1265	1040.00 Y 3.00 Z
Y 1020.00 Z 3.00	.4031	.3499	.3014	.2604	.2295	.2019	.1761	.1570	.1408	.1277	1020.00 Y 3.00 Z
Y 1000.00 Z 3.00	.4426	.3745	.3150	.2733	.2366	.2030	.1782	.1580	.1411	.1271	1000.00 Y 3.00 Z
Y 980.00 Z 3.00	.4845	.3952	.3342	.2835	.2383	.2052	.1792	.1579	.1407	.1255	980.00 Y 3.00 Z
Y 960.00 Z 3.00	.5247	.4235	.3497	.2862	.2407	.2061	.1782	.1561	.1387	.1233	960.00 Y 3.00 Z
Y 940.00 Z 3.00	.5710	.4500	.3543	.2871	.2408	.2032	.1755	.1535	.1352	.1199	940.00 Y 3.00 Z
Y 920.00 Z 3.00	.6175	.4564	.3573	.2865	.2355	.1980	.1693	.1480	.1300	.1149	920.00 Y 3.00 Z
Y 900.00 Z 3.00	.6273	.4597	.3489	.2764	.2246	.1878	.1615	.1401	.1232	.1091	900.00 Y 3.00 Z
Y 880.00 Z 3.00	.6222	.4419	.3278	.2554	.2067	.1734	.1499	.1309	.1154	.1032	880.00 Y 3.00 Z
Y 860.00 Z 3.00	.5735	.3933	.2883	.2247	.1848	.1588	.1379	.1214	.1077	.0968	860.00 Y 3.00 Z
Y 840.00 Z 3.00	.4583	.3163	.2366	.1916	.1617	.1412	.1243	.1103	.0992	.0894	840.00 Y 3.00 Z
Y 820.00 Z 3.00	.3048	.2266	.1823	.1546	.1370	.1223	.1100	.0994	.0905	.0825	820.00 Y 3.00 Z
Y 800.00 Z 3.00	.1439	.1354	.1266	.1193	.1130	.1049	.0966	.0895	.0823	.0759	800.00 Y 3.00 Z
Y 780.00 Z 3.00	.1533	.1432	.1337	.1271	.1176	.1083	.0997	.0915	.0838	.0770	780.00 Y 3.00 Z

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FULL  DAYFILE.  78/02/17. 09.34.55.*09.08.55* PAGE    1

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09.09.03.LIGHTIO(TAPE2)
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09.34.55.DAYFILE.
```

20-27

SAC-NR-76-02

PERIMETER LIGHTING PROBLEM -- METHODOLOGY

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ATTACHMENT 21
p 21-1

PREFACE

Perimeter lighting of a guarded area is used as a nighttime aid in the detection and prevention of unauthorized entry. Because of increased energy costs, it is important to design these lighting systems to meet specified illumination levels at near minimum operating costs as well as at low acquisition costs.

The analysis was conducted in response to a request from the Design and Construction Management Division under the Deputy Chief of Staff, Engineering and Services (CINCSAC/DE), of Headquarters, Strategic Air Command, U. S. Air Force.

The objective of the analysis was to explore methodology for determining luminaire location, height, and aiming direction parameters for use in cost comparisons. This analysis was directed at a practical solution to the perimeter lighting problem and does not employ sophisticated mathematical methods such as nonlinear optimization techniques. Basic assumptions required for simplified computations are analyzed in the report, and mathematical formulations of the perimeter lighting problem are given in the report annexes.

21-2

TABLE OF CONTENTS

2-3

LIST OF FIGURES

LIST OF TABLES

21- 4

PERIMETER LIGHTING PROBLEM -- METHODOLOGY

1. BACKGROUND

a. The electrical lighting systems which provide perimeter lighting for security purposes at numerous DoD installations are to be redesigned. A detailed study is underway to derive "lighting arrangements that would best meet the prescribed illumination requirements, both photometrically and economically." The U.S. Army Engineer District, Omaha, Corps of Engineers, has produced a draft study[1] fully describing the parameters of the problem and preliminary results from which the above quoted objective is abstracted.

b. CINCSAC/DE has requested NR to explore methodology to address perimeter lighting within the following ground rules:

(1) The constraint of minimum light inside the fence would be dealt with by shielding and thus need not be addressed.

(2) The lighting solution can be examined with respect to a straight fence (effect of corners negligible.)

(3) Target for solution should be within one to two percent.

(4) Solutions for a pole height of 15 feet and below should be addressed first.

(5) Adaptation to a fixed pole height of 15 feet should be examined later.

(6) Only the case of the single fence should be addressed.

(7) The purpose of assistance is to examine methodology only.

(8) The problem of area lighting, also treated in the draft study, was not at this time included in the NR task.

c. Two complementary approaches to the problem were taken. The first approach examined the problem analytically to uncover any general considerations of importance and to reduce, if possible, the number of variables that had to be examined. The second approach developed computational methods, short of complex nonlinear optimization techniques, to calculate the near-best solution over at least some of the critical

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1 Draft Lighting Study Security Systems Modifications, U.S. Army Engineer District, Omaha, Corps of Engineers, Omaha, Nebraska, December 1975

incident light performance factors. ANNEX A provides formulas for calculating incident light, and ANNEX C provides an interpolation method for deriving precise angular luminaire output.

2. SIMPLIFIED GEOMETRY

a. In order to simplify the analysis, all angles are defined in terms of their horizontal and vertical component angles. There are three types of angles considered: offset angles, luminaire aiming angles, and luminaire candle power angles. These are defined for a luminaire, a luminaire pole line, and a constraint line parallel to the pole line along which lighting requirements must be satisfied. (See Figure 1.)

(1) Horizontal Offset Angle θ

The angle formed by a line from the luminaire and perpendicular to a constraint line and a line from the luminaire to a point of interest on the constraint line, as projected on a plane parallel to the ground.

(2) Horizontal Aiming Angle θ_A

The angle formed by a line from the luminaire and perpendicular to a constraint line and a line from the luminaire in the direction that the luminaire aiming vector is pointed, as projected on a plane parallel to the ground.

(3) Horizontal Beam Angle θ_L

The angle formed by the luminaire aiming vector and a line from the luminaire to a point of interest on the constraint line, as projected on a plane parallel to the ground. The luminaire aiming vector is normally in the direction of greatest luminaire candle power intensity.

b. From the above definition, it follows that

$$\theta_L = \theta - \theta_A \qquad \text{---------------------------} \qquad (1)$$

c. Luminaire candle power is defined in terms of luminaire beam angles. Let $F(\theta_L, \gamma_L)$ denote the luminaire candle power for a luminaire horizontal beam angle of θ_L and a luminaire vertical beam angle of γ_L. Using Equation (1) above, we can derive luminaire candle power in the offset direction of interest

$$f(\theta, \gamma) = F(\theta - \theta_A, \gamma - \gamma_A) \qquad \text{----------------} \qquad (2)$$

GEOMETRY OF ANGLES ON THE

HORIZONTAL PLANE

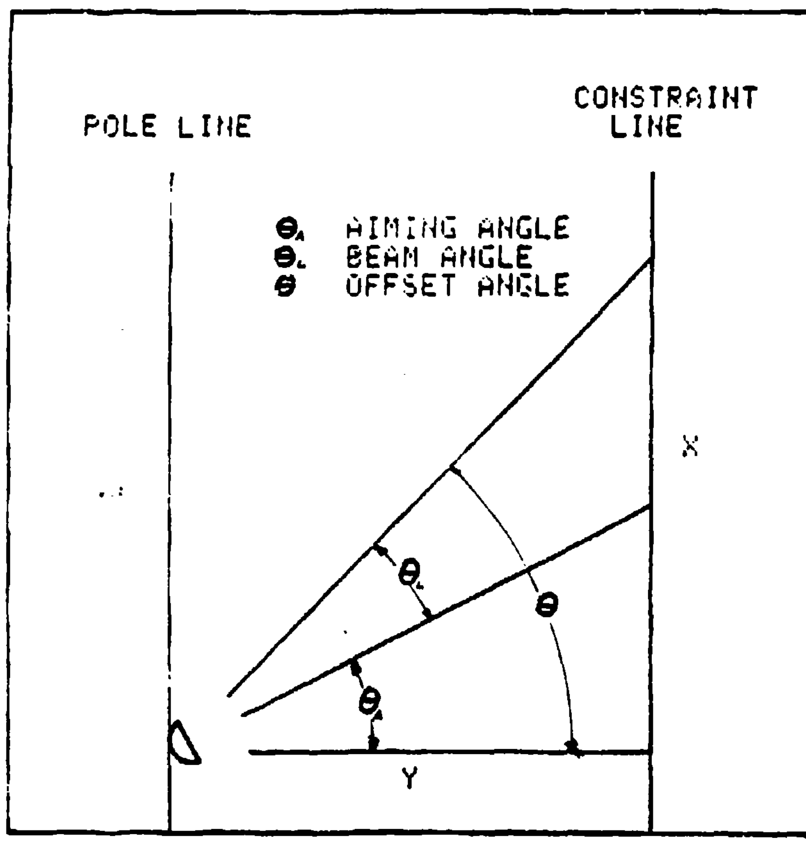


FIGURE 1

d. When we consider only the effects of candle power in the horizontal plane for a luminaire with horizontal aiming angle equal to zero, Equation (2) is simplified

$$f(\theta) = F(\theta) \quad \text{------------------------} \quad (3)$$

so that the luminaire candle power in the horizontal offset direction of interest can be expressed directly in terms of the luminaire candle power.

e. We can now write a simplified equation of foot candles incident to the vertical surface through the constraint line as a function of horizontal offset angle. Let $I(\theta)$ denote the component of luminaire candle power incident to the vertical constraint surface and $g(\theta)$ denote foot candles. Then,

$$g(\theta) = \frac{f(\theta) \cdot I(\theta)}{d^2} \quad \text{-------------------} \quad (4)$$

where

$$d = y \sec\theta \quad \text{------------------------} \quad (5)$$

and

$$I(\theta) = \cos\theta \quad \text{------------------------} \quad (6)$$

so that

$$g(\theta) = \frac{f(\theta)\cos^3\theta}{y^2} \quad \text{------------------------} \quad (7)$$

f. The constraint lines run parallel to the fence and line of lighting poles. The constraint lines, lighting pole line and distance constraints are shown in Figure 2.

g. Analogous definitions can be made for vertical offset angle γ, vertical aiming angle γ_A and vertical beam angle γ_L. Most of the following discussions are in terms of horizontal angles. Hence, detailed definitions of vertical angles are omitted here.

3. <u>MAXIMUM POLE SPACING</u>

a. There are certain discrete combinations of lighting equipments that can be compared in the lighting problem. These consist of luminaire type/luminaire wattage and number of luminaires on a lighting

PERIMETER LIGHTING

GEOMETRIC CONSTRAINTS

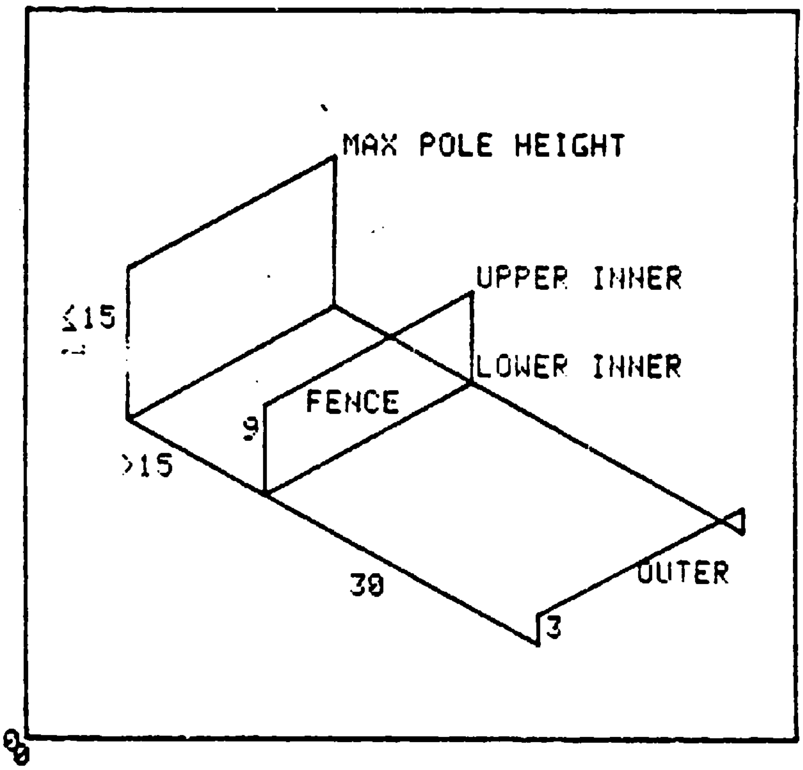


FIGURE 2

21-9

pole. Let us define these combinations as luminaire configurations. There are also luminaire arrangements describing where the luminaires are located and pointed. These variables are continuous and include distance the lighting poles are behind the fence and are apart, the height of the luminaires on the pole, and the angle the luminaires are aimed. Let us define these as arrangement variables.

b. Pole spacing is defined as the distance between poles such that lighting requirements are met everywhere along the constraint lines. For instance, if the lighting requirement was satisfied at horizontal offset distances out to a hundred feet except for an interval between 40 and 50 feet, the pole spacing would be 40 feet. In order to insure that this definition was met, a procedure was adopted to test the lighting requirements by incrementing offset distance successively from zero offset to larger offsets.

c. A luminaire configuration can have a multitude of arrangements. For any two arrangements that meet the lighting requirements, the lower cost arrangement is the one that has the larger pole spacing. It should be noted that this principle is independent of the cost of pole installation. From this principle our efforts were directed in finding a method for deriving a maximum pole spacing arrangement for a luminaire configuration. Once this methodology is obtained, a best arrangement solution can be obtained for each luminaire configuration. The installation and 10-year operating cost of each luminaire configuration can then be computed directly and compared.

d. By this procedure, cost factors can be applied after the search for the best lighting arrangement, greatly simplifying the problem.

4. MEASURE OF LIGHTING EFFICIENCY

a. The luminaire candle power required to satisfy the lighting constraints depends on luminaire distance and direction to the vertical surface along the constraint. Writing the equation for incident foot candles defined in paragraph 2e, we have

$$g(\theta) = \frac{f(\theta)\cos^3\theta}{y^2} \quad \text{--------------------} \quad (8)$$

Setting $g(\theta) = C$, a particular constraint requirement, and solving for $f(\theta)$, we have

$$f(\theta) = \frac{C \cdot y^2}{\cos^3\theta} \quad \text{------------------------} \quad (9)$$

2'-·J

b. The candle power required to satisfy a constraint in constant foot candles increases with offset angle θ as shown below

$$R(\theta) \sim \frac{1}{\cos^3 \theta} \quad \text{-------------------------} \quad (10)$$

The pole spacing achieved for a given pole distance and offset angle is proportional to tan θ:

$$P(\theta) \sim \tan \theta \quad \text{-------------------------} \quad (11)$$

A measure of lighting efficiency is the pole spacing achieved per required candle power:

$$M(\theta) \sim P(\theta)/R(\theta) \quad \text{-------------------------} \quad (12)$$

Substituting Equations (10) and (11) in Equation (12), we get

$$M(\theta) \sim \tan \theta \cos^3 \theta \quad \text{-------------------------} \quad (13)$$

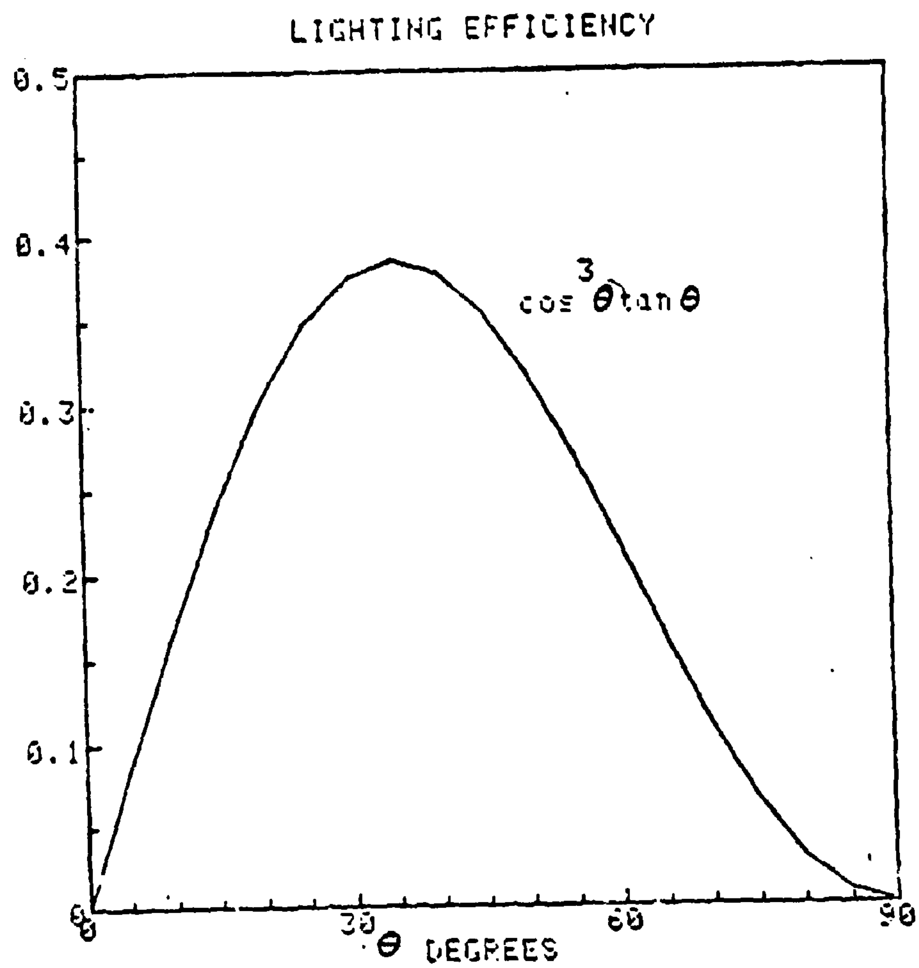
c. The graph of Equation (13) is given in Figure 3. Lighting efficiency peaks at a horizontal offset angle of about 35°. This suggests that adding light intensity until the constraint is met at approximately 35° is efficient. Adding light intensity to meet the constraint beyond 35° is inefficient. (See Figure 3.) Since luminaire wattages are discrete values, it is not always possible to satisfy the constraint near 35°. The most efficient use of lighting would then be the discrete value of lighting available that yields the highest value or is closest to the peak.

d. Equation (13) should not be used for calculating pole spacing. Its use is restricted, being affected by beam pattern, wattage cost, discrete wattages, aiming angle, etc. However, it is given to provide some objective guidance to what is intuitively apparent, i.e., it is wasteful to over-illuminate in the center in an effort to extend the offset.

> Note: The most efficient pole spacing in terms of our restrictive measure can be derived by setting $M'\theta = 0$, solving for θ, and then converting from offset angle θ to pole distance $2\,Y \tan \theta$.

$$M(\theta) = \cos^3 \theta \tan \theta$$

$$M'(\theta) = \cos^3 \theta - 2 \sin^2 \cos \theta = 0$$



LIGHTING EFFICIENCY
0.5
0.4
0.3
0.2
0.1
0
0
30
60
90
$\cos^3\theta\tan\theta$
θ DEGREES

FIGURE 3

Substituting $1 - \sin^2 \theta$ for $\cos^2 \theta$ we have,

$$\sin^2 \theta = 1/3$$

$$\theta = 35^{0}\ 16'$$

$$2\ Y \tan \theta = 1.155\ y.$$

Hence, maximum lighting efficiency is achieved when pole spacing is slightly greater than pole distance to the lighting constraint.

5. WHEN TO ADD LUMINAIRES

The last section suggests that it sometimes might be more efficient to add luminaires than to increase pole spacing. As indicated, this would be when the incident light from a single luminaire yielded a very small pole spacing. A guide for adding luminaires can be obtained directly by comparing the incident light from one luminaire at an offset X, to that of two luminaires at an offset 2X, and to that of three luminaires at an offset 3X, etc. There is a range of offset X for which the greatest incident light is provided by 1 luminaire, 2 luminaires, 3 luminaires, etc. The smaller the offset X achieved by one luminaire, the greater the number of luminaires are required to provide the maximum pole spacing. Figure 4 illustrates this fact for 1 through 4 luminaires. The solid portion of each curve depicts when and how many luminaires would yield the greatest pole spacing per luminaire. For very narrow angle luminaires, it might be impractical to add luminaires. However, for any luminaire we can at least deduce the general rule that luminaires should not be added if the pole space achieved by a single luminaire is greater than the pole distance Y.

6. LIGHTING PARAMETERS

a. So far we have examined pole spacing as a measure of lighting performance. We have considered its relation to efficiency and luminaire power in a general way taking into consideration the effect of distance and incident angle. We shall next examine the lighting parameters. These are summarized in Table I.

2'-13

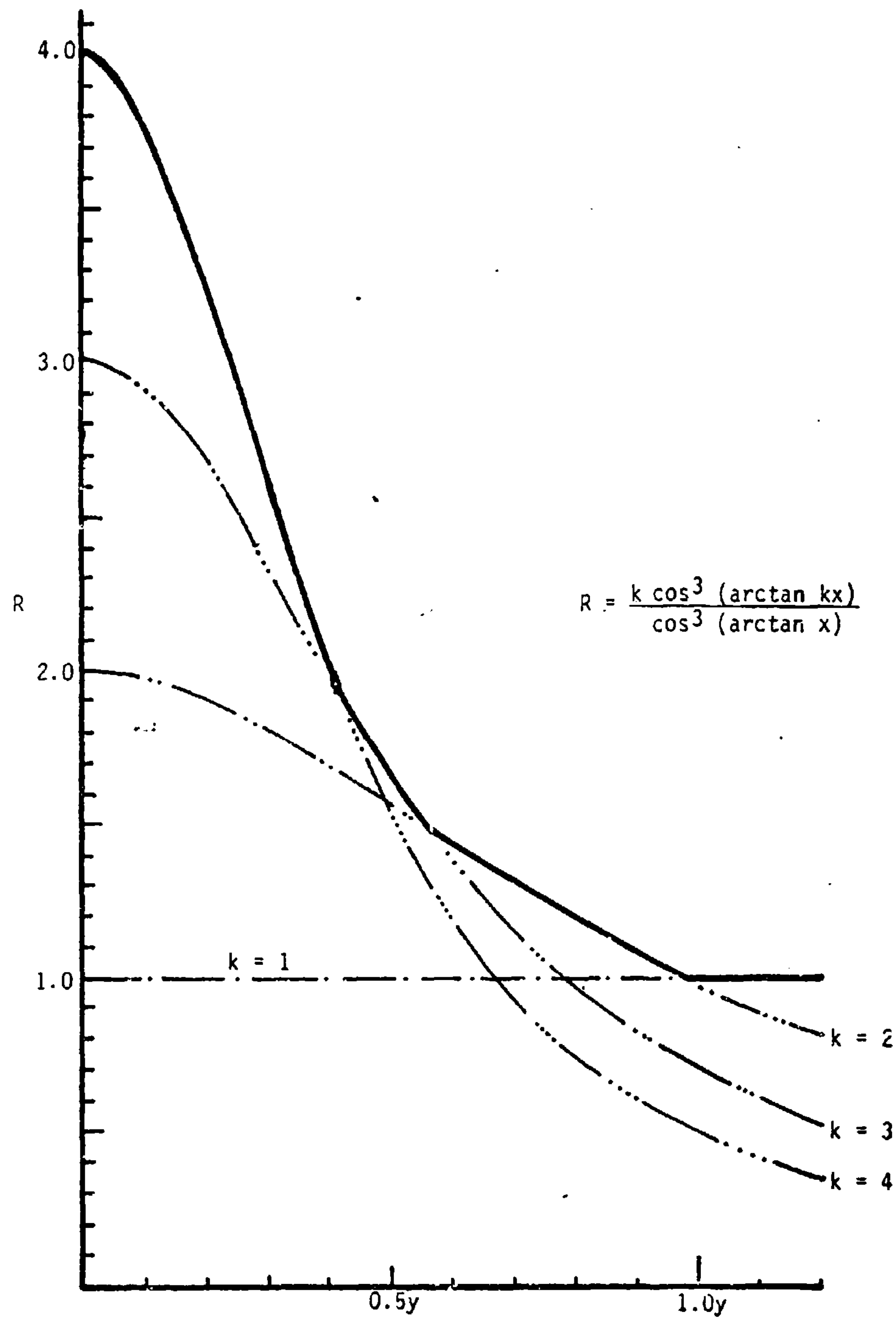


Figure 4. Greatest Pole Spacing Per Luminaire

21-11

TABLE I

MAXIMUM POLE SPACING PARAMETERS

Configuration Parameters	Arrangement Parameters	Requirement Parameters
Luminaire Type/Wattage	Independent	Outer Constraint
Number of Luminaires	Pole Height Z Pole Distance Y	Upper Inner Constraint
	Vertical Aim Horizontal Aim (Multi-Luminaires)	Lower Inner Constraint
	Dependent	
	Vertical Beam Angle Horizontal Beam Angle	

b. Configuration Parameters

There are 25 luminaires to examine. Several luminaires of the same type can be used at the same time. If combinations of one, two, and three luminaires are considered, there would be 75 configurations to examine. The configurations must be examined separately. They are discrete parameters in the search process.

c. Arrangement Parameters

These are continuous parameters and when considered simultaneously, offer efficiencies in the search process. It is desirable to simplify the manner in which the lighting arrangements are evaluated. There are four independent lighting arrangement parameters; namely, pole height, pole distance Y, vertical aim, and horizontal aim for multi-luminaire configurations. Given any lighting arrangement and measurement point along a constraint, the vertical and horizontal beam angles can be determined, and thus these are defined as dependent variables necessary for the computation of incident light.

d. Requirement Parameters

Lighting requirements must be met along each of the constraint lines. The requirements are considered as parameters in the computer program. First, they are subject to changes in criteria. Second, they might be adjusted to account for additional factors. For instance, if one introduced dirt accumulation as a factor, it could be treated as a degrade factor in calculating illumination, but it could also be treated as an increased illumination requirement.

2!-/5

7. FIXING POLE HEIGHT

a. A pole height of three feet would yield the maximum foot candles at the outer constraint as a function of pole height. However, this pole height is not good for satisfying the inner constraints. The vertical offset angle to the upper inner constraint would be much greater than to the lower inner constraint. The inner constraints could be more equally satisfied by raising the pole height. A good solution would be obtained by fixing pole height so that the luminaire could be aimed midway between the two inner constraint heights.

b. A measure of the fractional loss of illumination as a function of pole height is given in Equation (14):

$$L(Z-H) = 1 - \cos^3 (\arctan ((Z-H)/\sqrt{X^2+Y^2})) \quad \text{-----------} \quad (14)$$

where

X is offset distance

Y is pole distance

Z is pole height

H is constraint height

and

Z-H is height of lighting pole above or below the constraint.

By definition, when Z-H equals zero, we have no fractional loss in illumination at the constraint.

The relative effect of pole height on the fractional loss of illumination on the inner constraints versus the outer constraint was examined using Equation (14). Figures 5, 6, and 7 display results for minimum pole distance, zero offset; increased pole distance, zero offset; and minimum pole distance, increased offset. In each case the effect of pole height on the inner constraints were proportionately much greater than on the outer constraint. It is concluded that in general more is gained by adjusting pole height to 4.5 feet which is optimum for the inner constraints than lost by adjusting pole height higher than 3.0 feet which is optimum for the outer constraint. In a specific case where the inner constraints are easily satisfied whereas the outer constraint is not, there still

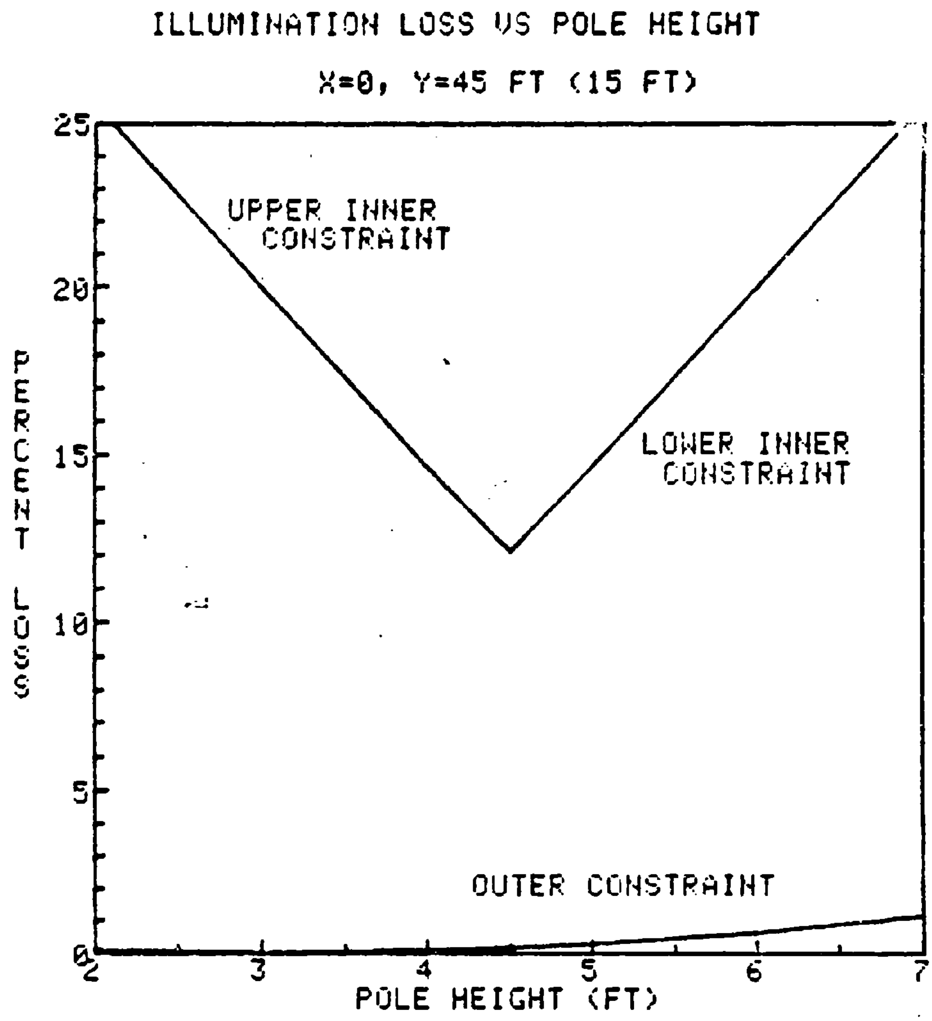
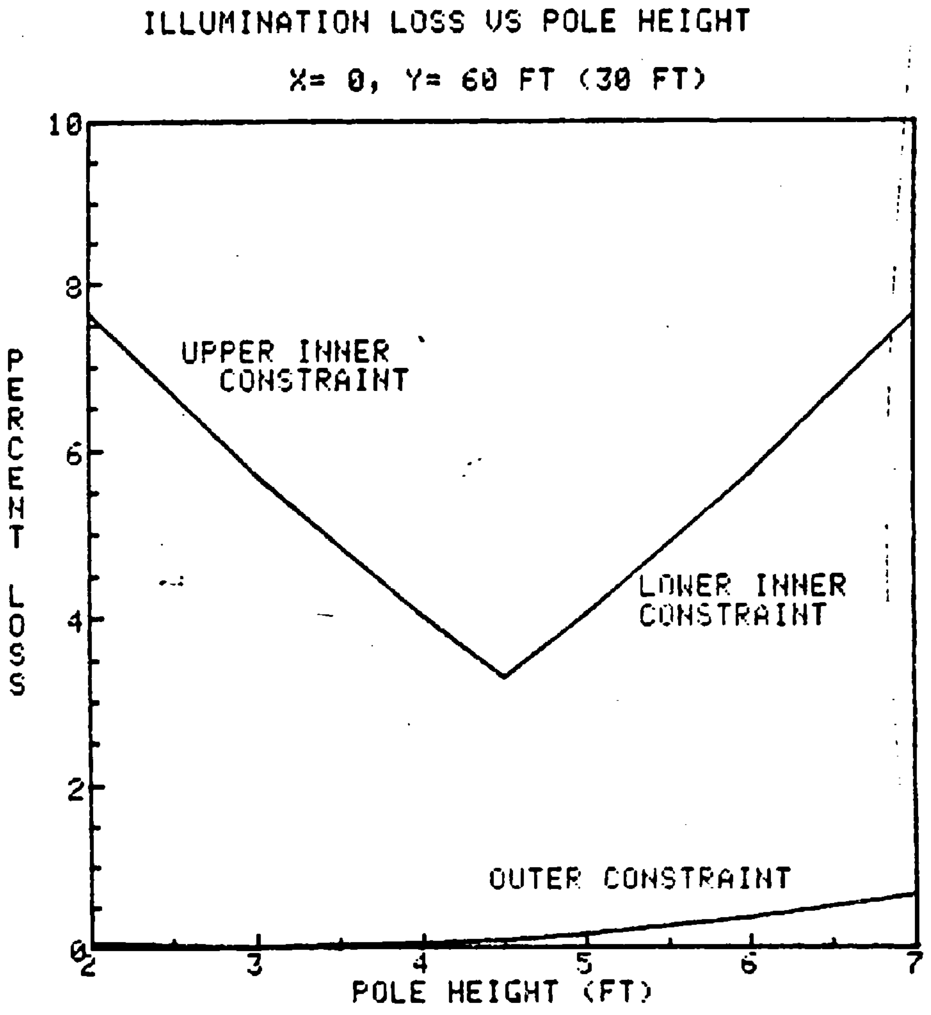


FIGURE 5

21-17



ILLUMINATION LOSS VS POLE HEIGHT
X= 0, Y= 60 FT (30 FT)
10
8
6
4
2
0
PERCENT LOSS
UPPER INNER CONSTRAINT
LOWER INNER CONSTRAINT
OUTER CONSTRAINT
2
3
4
5
6
7
POLE HEIGHT (FT)

FIGURE 6

21-1

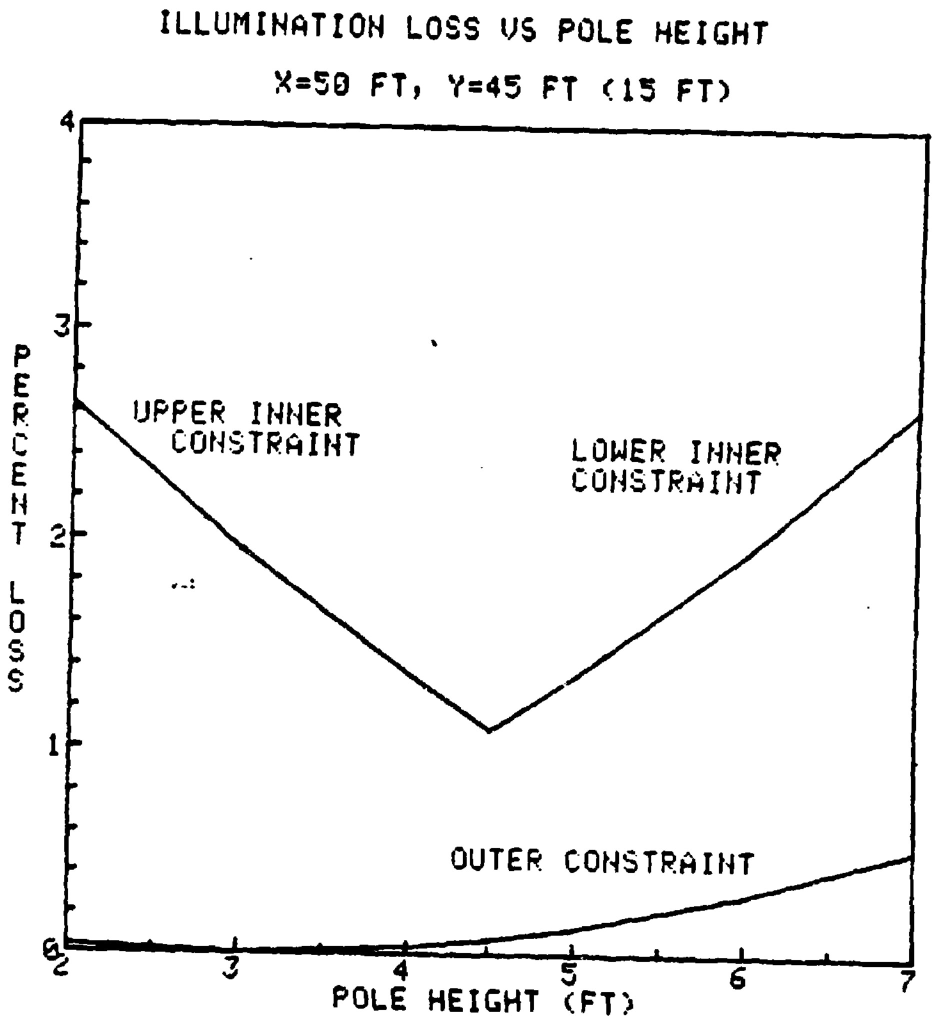


FIGURE 7

21-17

would be less than a one percent loss of illumination. The effect of this loss of illumination would have even a smaller effect on pole spacing.

c. By fixing pole height to 4.5 feet, we have effectively eliminated one of the independent arrangement parameters that have to be searched. This leaves only arrangements of pole distance, vertical aim and horizontal aim to be searched. Assuming we were going to search each arrangement parameter n times, the deletion of one parameter would reduce the search from n^4 combinations to n^3 combinations, a substantial reduction.

8. INNER CONSTRAINTS

a. The inner constraints are far more sensitive to the horizontal offset angle because they require a far greater offset angle than for the outer constraint to achieve the same offset distance. Figure 8 illustrates the worst case when the lighting pole is the minimum distance (15 ft) behind the fence. This difference becomes less crucial the further the lighting pole is moved back. It was soon discovered after some computer searches that the inner constraint was overriding for many luminaire types, especially those with narrow beam patterns. The searches consisted of moving the lighting pole back reducing the pole spacing achieved for the outer constraint, at the same time increasing the pole spacing achieved for the inner constraint until they became the same. It became evident that the use of multiple beams at plus and minus horizontal aiming angles could greatly improve results for narrow beams against the inner constraints.

b. An algorithm was devised for determining the maximum pole spacing over the constraints. Let us denote the maximum pole spacing for a given constraint as "P.S.". Then the maximum pole spacing for all constraints will be the least valued P.S. Let us denote this as "Min. P.S.". The Min. P.S. should be computed for the lighting pole 15 feet behind the fence. Then the distance should be increased a small amount and the Min. P.S. should be re-computed. If it does not increase, there is no need to test for greater distances behind the fence and the desired Min. P.S. is obtained. After repeating this process for vertical and horizontal aiming angles, the greatest Min. P.S. is obtained. (See Paragraph 12 for flow chart.)

9. MULTIPLE LUMINAIRE CONFIGURATIONS

a. An additional dimension of search, as compared to the single luminaire configuration, is required when evaluating two and three

21-23

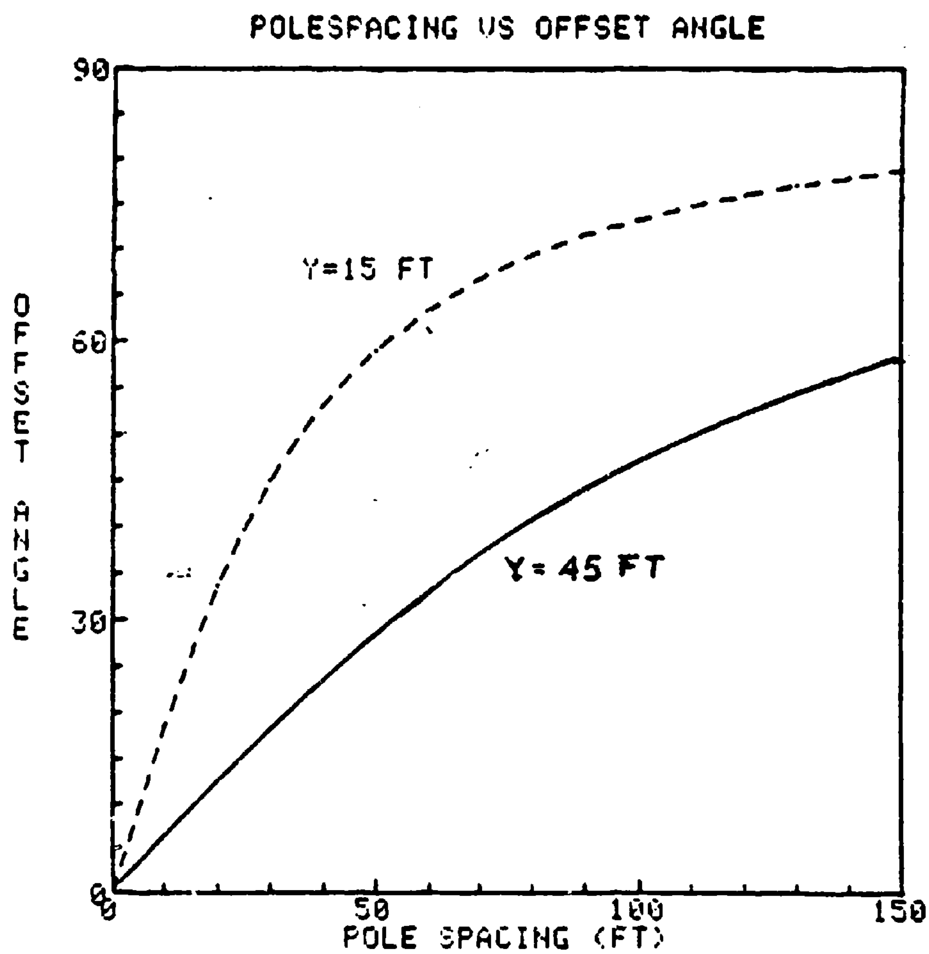

POLESPACING VS OFFSET ANGLE
90
60
30
0
OFFSET ANGLE
Y=15 FT
Y= 45 FT
0
50
100
150
POLE SPACING (FT)

FIGURE 8

luminaire configurations. In the two-luminaire configurations, a search of greater and greater plus and minus horizontal aiming angles would be needed until the maximum pole spacing was reached. The three-luminaire configurations would involve the same search procedures as in the two-luminaire case, except that a third luminaire with zero horizontal aiming angles would be added.

b. Multiple luminaire configurations can be examined as a single luminaire by rotating their beam patterns the amount of their horizontal aiming angle and adding.

10. ADDING LIGHT FROM ADJACENT POLES

a. So far we have introduced the concept of pole spacing as a measure of lighting performance (paragraphs 1-5) and have considered the lighting parameters and possible simplifications in their use (paragraphs 6-9). We now wish to return to pole spacing and two crucial issues involved in adding light from adjacent poles.

b. Criteria of One-half the Required Incident Light

(1) We have derived the maximum horizontal offset from a lighting pole for which the required incident light is obtained, and called this distance one-half pole spacing. Assume this is the left hand pole of adjacent poles. Then, incident light from the right hand pole would add to that of the left. This means that less than the required amount of incident light would have to be supplied by the left hand light and "pole spacing" could be increased accordingly. It is logical to assume that the adjacent poles can be moved apart until exactly one-half of the required light is supplied by each pole. The new pole space distance, based on adjacent poles, would be equivalent to the one-pole case derived for one-half the required incident light. This yields a very neat solution for the two-pole case and can easily be generalized to additional poles to the left and right. However, implicit in this simplified solution, is the assumption that if lighting requirements are satisfied exactly in the middle of two poles, it is satisfied everywhere else between the poles. This is only true if the incident lighting function is decreasing in a linear or concave-up fashion. Figure 9 illustrates this relation. The absolute value of the increase in illumination from the nearer light as one approaches it (here shown as Δ_R) is always greater than the decrease in illumination from the farther light (here shown as Δ_L), from which one is receding. The sum of the two lights (here shown as $I_L + I_R$) is always greater than or equal to the required incident light C.

(2) Foot candle functions, f (θ), are generally the opposite, concave-down. For example, if f (θ) = cos θ along the horizontal

21-22

CONDITION FOR MINIMUM LIGHT
MIDWAY BETWEEN POLES

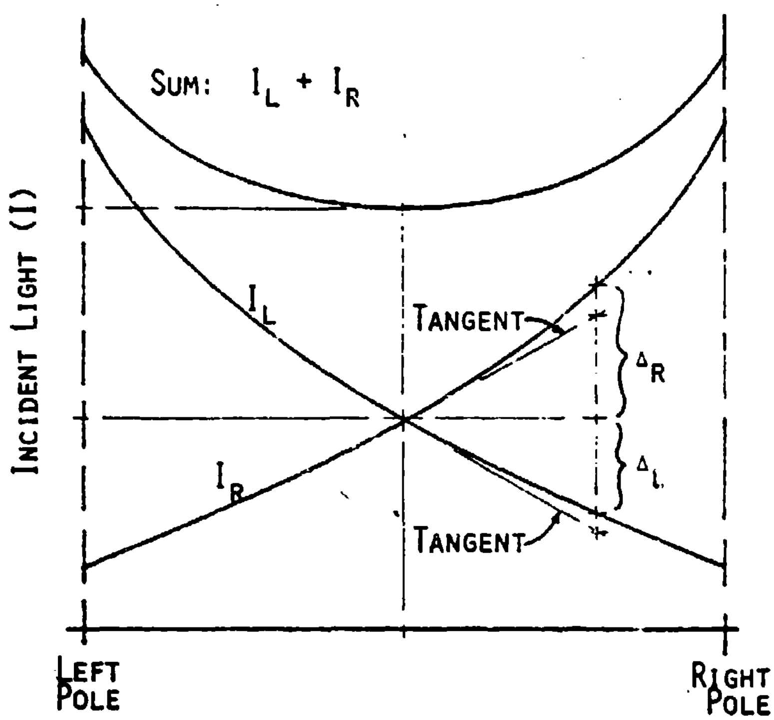


FIGURE 9

21-23

beam, it would never be concave-up. However, we should not rely on intuition. Since the foot candle function, f (θ), is multiplied by $\cos^3 \theta$ in the incident light equation, it is more likely to be transformed into a concave-up function. Let us see when this is true using the incident light equation:

$$g(\theta) = \frac{f(\theta)\cos^3\theta}{y^2} \qquad \text{------------------------} \qquad (15)$$

Assume $f(\theta) = K$, and compute the rate of change of the slope of $g(\theta)$, equivalent to its second derivative

$$g'(\theta) = \frac{-3K}{y^2}\cos^2\theta\sin\theta \qquad \text{----------------------} \qquad (16)$$

and

$$g''(\theta) = \frac{-3K}{y^2}\cos^3\theta - 2\cos\theta\sin^2\theta \qquad \text{----------} \qquad (17)$$

Solving for $g''(\theta) = 0$, we get $\tan^2\theta = 0.5$ and $\theta = 35^{\circ}\ 26'$.

(3) A plot of $g''(\theta)$ is given in Figure 10. The rate of change of the incident light function $\cos^3\theta$ changes from positive to negative at $35^{\circ}\ 26'$ and is a maximum negative rate at about 60°. The greater the negative rate of change of a function, the greater is the extent that it is concave-up.

(4) When $f(\theta)$ is moderately concave-down, the situation is even improved. For example, when, as we stated before, $f(\theta) = \cos\theta$ the inflection point is equal to 30°.

(5) The only case of concern appears to be when $f(\theta)$ drops off very rapidly to zero. The pole spacing would have to be reduced until the one-pole case provided the full lighting requirement. The lighting input tables could be adjusted to denote exactly where a drop-off occurred. However, it might be simpler to compute the sum of the left and right light sources when the one-pole source provides less than 1.0 of the incident light requirement.

c. Additional Light from Distant Poles

(1) Previous discussion has been based on measuring incident light from the immediate pole (left or right) to the mid-pole

g" OF INCIDENT LIGHT

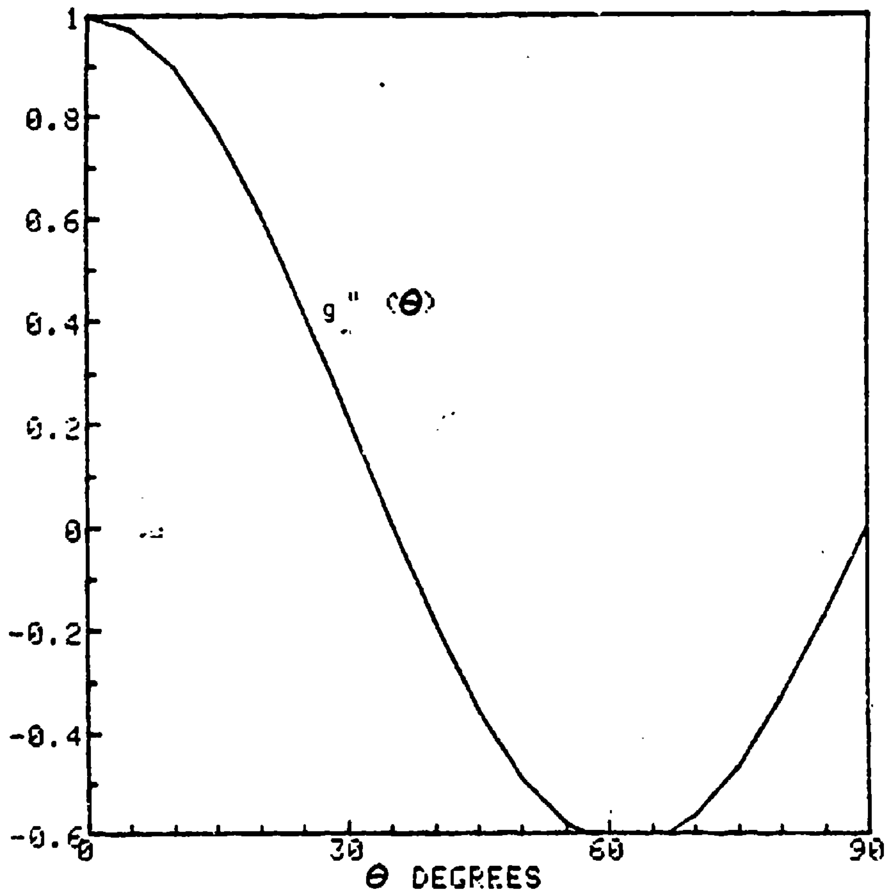


FIGURE 10

21.25

position along the constraint. An offset distance x was used to denote this distance to the first pole. Additional incident light is supplied to the mid-pole distance from more distant poles. The offset distance to the mid-pole position as a function of the kth distant pole is given by

$$x_k = (2k-1)\, x \qquad (18)$$

The general equation of incident light is given by

$$I = F(\theta,\gamma) \cdot \frac{y}{d} \cdot \frac{1}{d^2} \qquad (19)$$

where $F(\theta,\gamma)$ is luminaire foot candles

$\frac{y}{d}$ is component of incident light on the vertical surface of the constraint

d is distance

Substituting x, y, and z into the distance equation and using Equation (19), the incident light obtained from the kth pole is given by

$$I_k = F(\theta,\gamma)\, y \cdot \left[((2k-1)\, x)^2 + y^2 + z^2\right]^{-3/2} \qquad (20)$$

By substituting a constant for $F(\theta,\gamma)$ in Equation (20), we can determine the proportion of incident light provided by the kth pole independent of the luminaire foot candle pattern. This allows the summation of I_k terms.

Let $A_n = \sum_{k=1}^{n} I_k$ for all significant terms of I_k,

such that $I_{k>n} < .001$.

Then, the error for using only m pairs of poles is given by

$$E_m = (A_n - \sum_{k=1}^{m} I_k)/A_n \qquad (21)$$

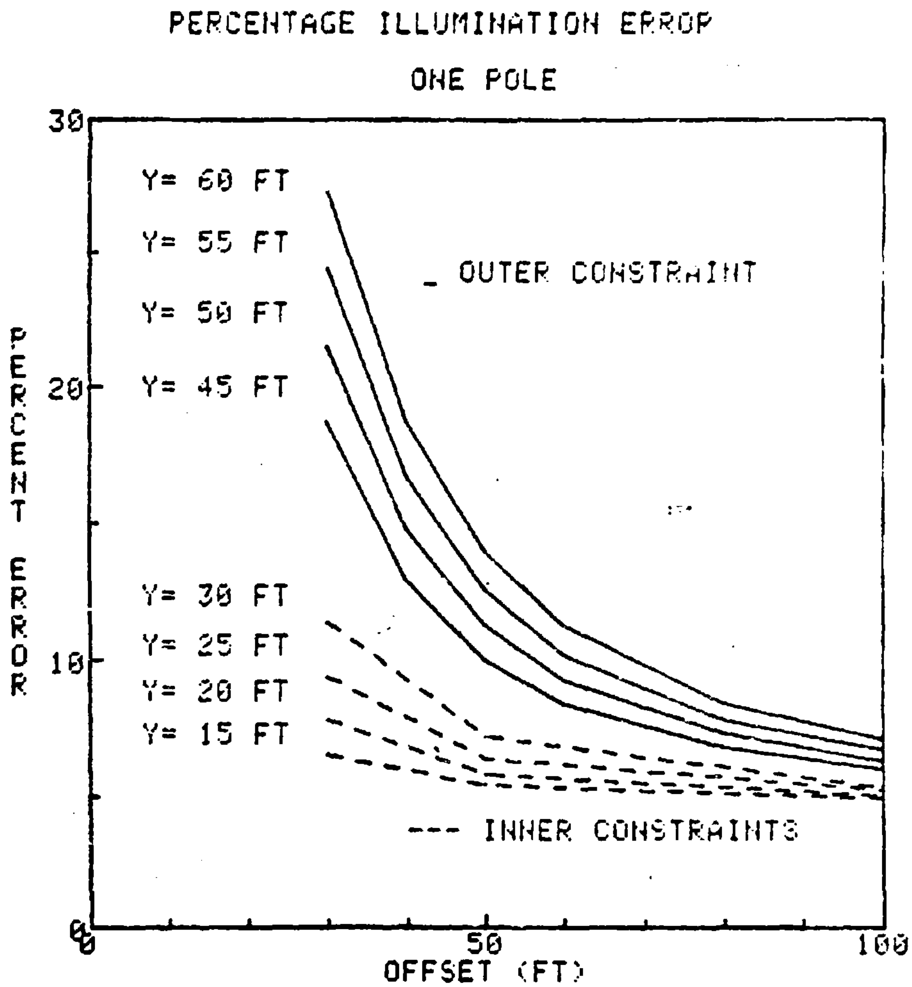


FIGURE 11

21-27

PERCENTAGE ILLUMINATION ERROR

TWO POLES

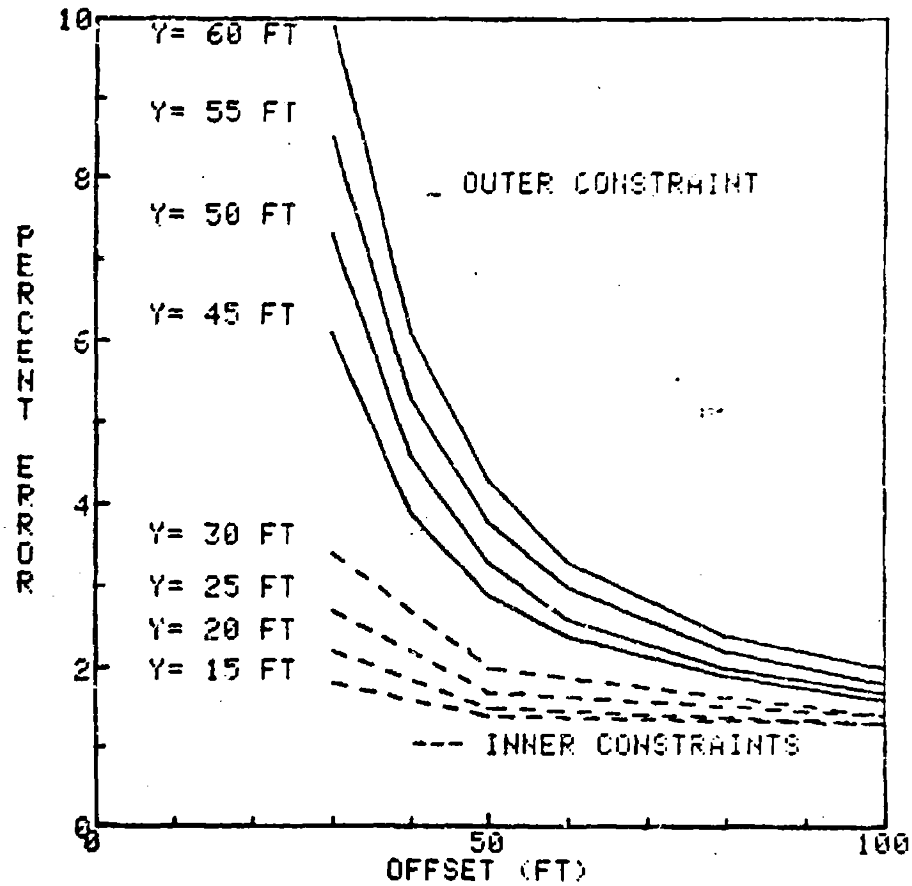


FIGURE 12

21-28

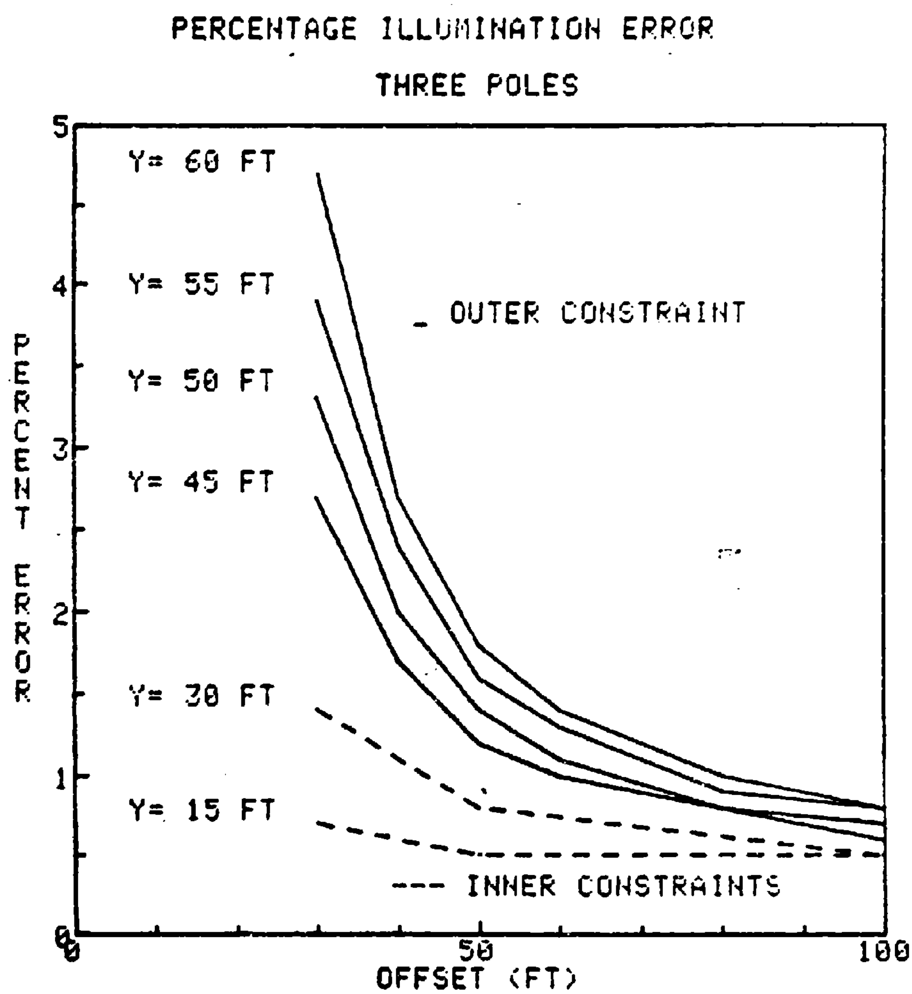


FIGURE 13

21-29

PERCENTAGE ILLUMINATION ERROR

FOUR POLES

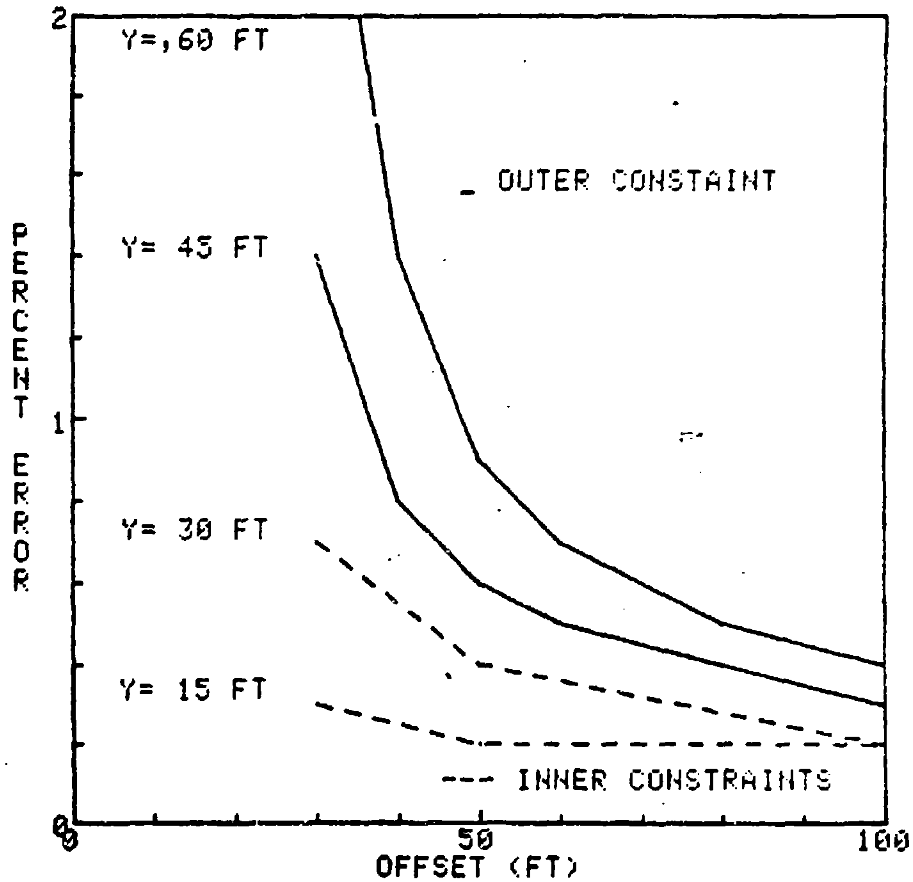


FIGURE 14

21-31

(2) Figures 11 through 14 show the upper bound of the error when using, respectively, one, two, three, and four pairs of poles in computing incident light. The errors are given for both outer and inner constraints. The errors for the outer constraints are relatively greater than those for the inner constraints. In general, the error for the inner constraints using k poles approximates the error for outer constraints using k plus one pole. In every case the error rises sharply for small offset distances. However, as we have shown before, when the measure of pole spacing is small, it is better to add luminaires on each pole. In practice we are only interested in solutions that yield large pole spacings. The offsets for these cases are in fact much greater than 30 feet. Further, the error in pole spacing is proportionately less than the error in incident light. As was shown in paragraph 4, the greater the pole spacing the less efficient it is to add light (similarly to account for more light.)

(3) On the basis of the error analysis, it seems that using three pairs of poles for the outer constraint and two pairs of poles for the inner constraint would yield satisfactory results. The final decision should be based on the required accuracy, uncertainty in other factors, and computer parameters.

11. FIFTEEN-FOOT POLE HEIGHT CONSTRAINT

a. Luminaires do not require expensive hardening if they are mounted at a height of fifteen feet or above. The money saved in not hardening must be compared to the money lost due to a more expensive lighting arrangement. This can be done by comparing minimum-cost lighting arrangements between pole height mounting below fifteen feet and at fifteen feet. The fifteen-foot pole height constraint does, indeed, cause a large decrease in pole spacing compared to the unconstrained pole height case. This is due to the increased angles of incidence at the outer constraint and lower inner constraint. (See Figure 15 for incident angles γ_1 and γ_2.) Secondly, a greater spread in the luminaire's vertical beam is required to illuminate the constraints. (See Figure 15 for the angle difference γ_3.) This does not explain the entire problem because now the outer constraint is not between the two inner constraints, and if the highest intensity part of the luminaire beam is pointed at it, a relatively less intense beam will be directed at the lower inner constraint.

b. The methodological problems fortunately are not so much aggravated. Just as before, a search over the vertical aiming angle arrangement parameter is required. In this case, more search steps will be required and better interpolation of the vertical beam may

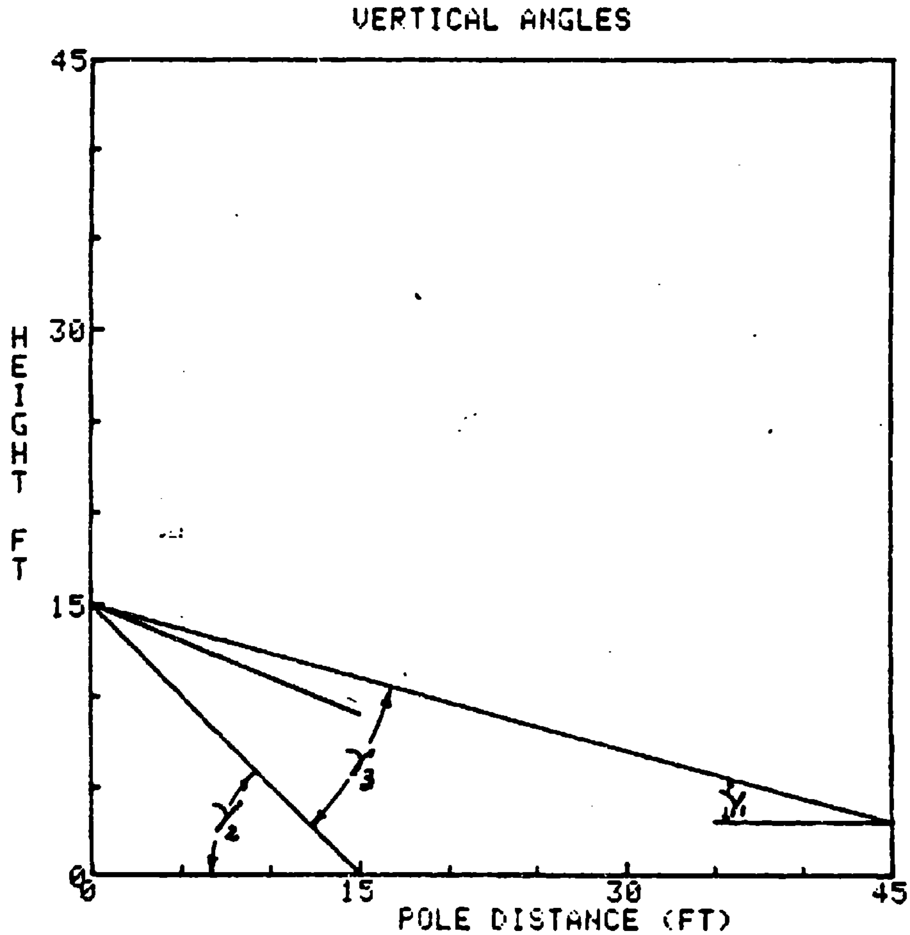


FIGURE 15

21-32

be required because the solution will be more sensitive to the vertical angle parameter. On the other hand, the search should be simpler because the upper inner constraint can be ignored.

c. Another possible solution would be to use more than one luminaire aimed at different vertical angles. For instance, one luminaire could be aimed towards the lower inner constraint and another towards the outer constraint. Similar procedures for varying luminaire vertical aiming angles could be adopted as derived for varying luminaire horizontal aiming angles.

d. A natural extension of the above solution would be to use luminaires with a combination of horizontal and vertical aiming angles. This solution is so complicated that it should be considered only after practical experience is obtained on the simpler luminaire configurations.

e. The solution for the fifteen-foot pole height is more complicated than for the fixed 4.5 foot pole height. Additional procedures for the fifteen-foot pole height should be attempted only after those for the simpler case have been checked out.

12. SUMMARY OF BASIC PROCEDURES

a. Analytic considerations have been described in this report for basing the design of a computer search routine for determining near low cost lighting arrangements that satisfy perimeter lighting requirements. Maximum lighting pole spacing has been suggested as the measure for comparing lighting arrangements between luminaire configurations. This greatly simplifies the problem because lighting performance measures and installation and operating cost factors are derived sequentially.

b. Our analysis was restricted to investigating procedures for deriving maximum pole spacing. The following assumptions for reducing the magnitude of computations were analyzed. An asterisk denotes when a computer test for reduced computation is suggested.

(1) Multi-Luminaire Configurations

Multi-luminaire configurations are most likely needed to improve the pole spacing for the inner constraints. These configurations are not likely to improve the solution for the outer constraint unless the maximum pole spacing for one luminaire is less than about the pole distance.

(2) Fixing Pole Height

One arrangement parameter can be eliminated by fixing pole height to the mid-height of the inner constraints.

(3) Inner Versus Outer Constraint*

Further increases in pole distance to achieve greater maximum pole spacing does not have to be considered when the maximum pole spacing achieved for all constraints decreases with an increase in pole spacing.

(4) One-Half Requirement*

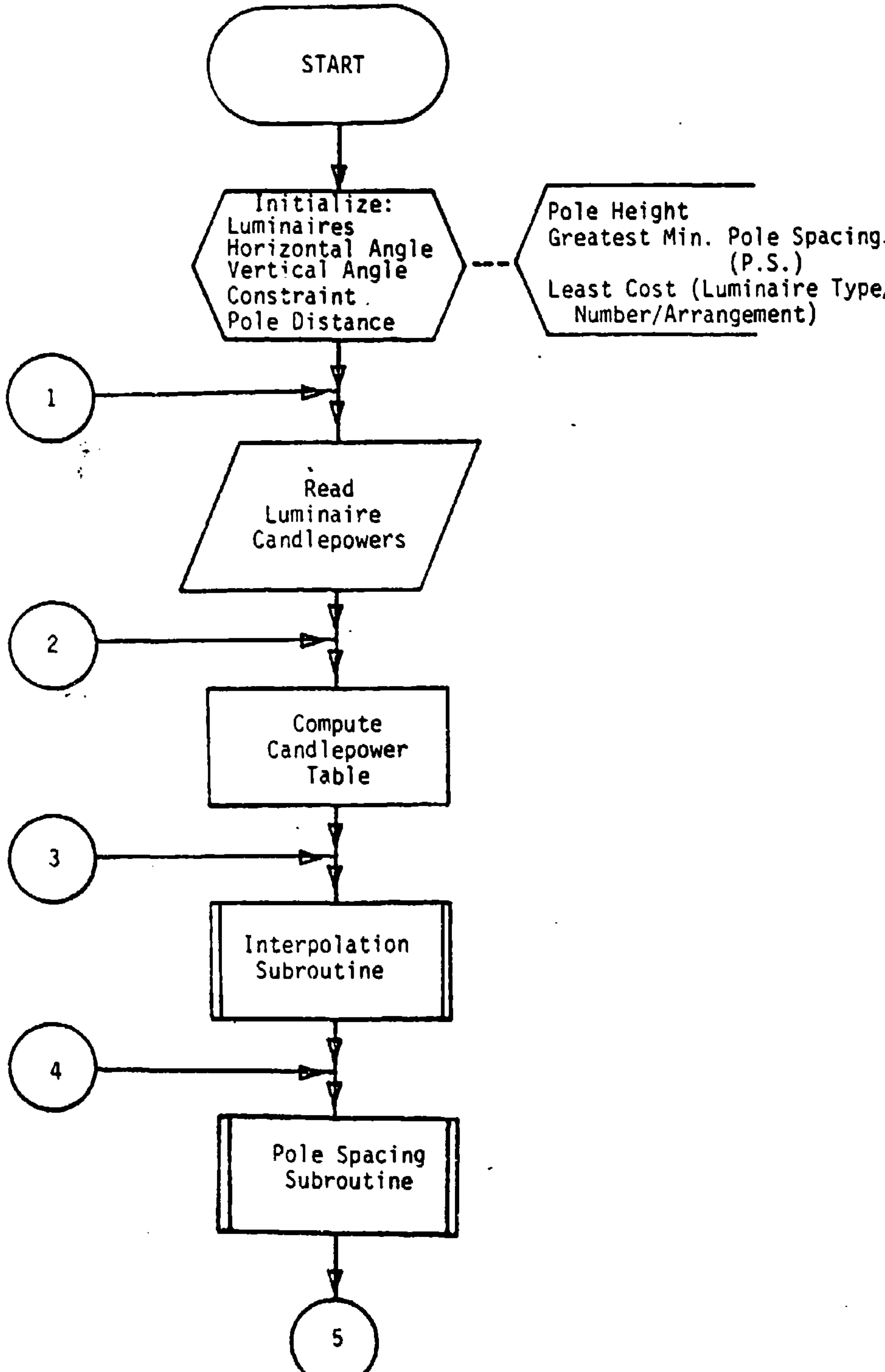
In general, the maximum pole spacing is achieved when either the left hand or right hand lighting sources provide 0.5 of the lighting requirement (incident lighting function concave-up). For an exact solution, the sum of the left and right hand lighting sources needs to satisfy 1.0 of the lighting requirement. This sum should first be checked for a pole spacing based on either left hand or right hand poles providing 0.5 of lighting requirement. If this fails, the sum should successively be checked for smaller pole spacings. A solution must occur when either left hand or right hand lighting sources provide 1.0 of the lighting requirement.

(5) Lighting from Beyond Adjacent Poles

A good approximation of the total incident light from luminaires along the pole line can be derived by using three poles for the outer constraint and two poles for the inner constraints. The sums for these poles can easily be computed by changing only the x term in the incident light equations. When the offset distance is x feet for the first pole, it will be 3x feet for the second pole, and 5x feet for the third pole.

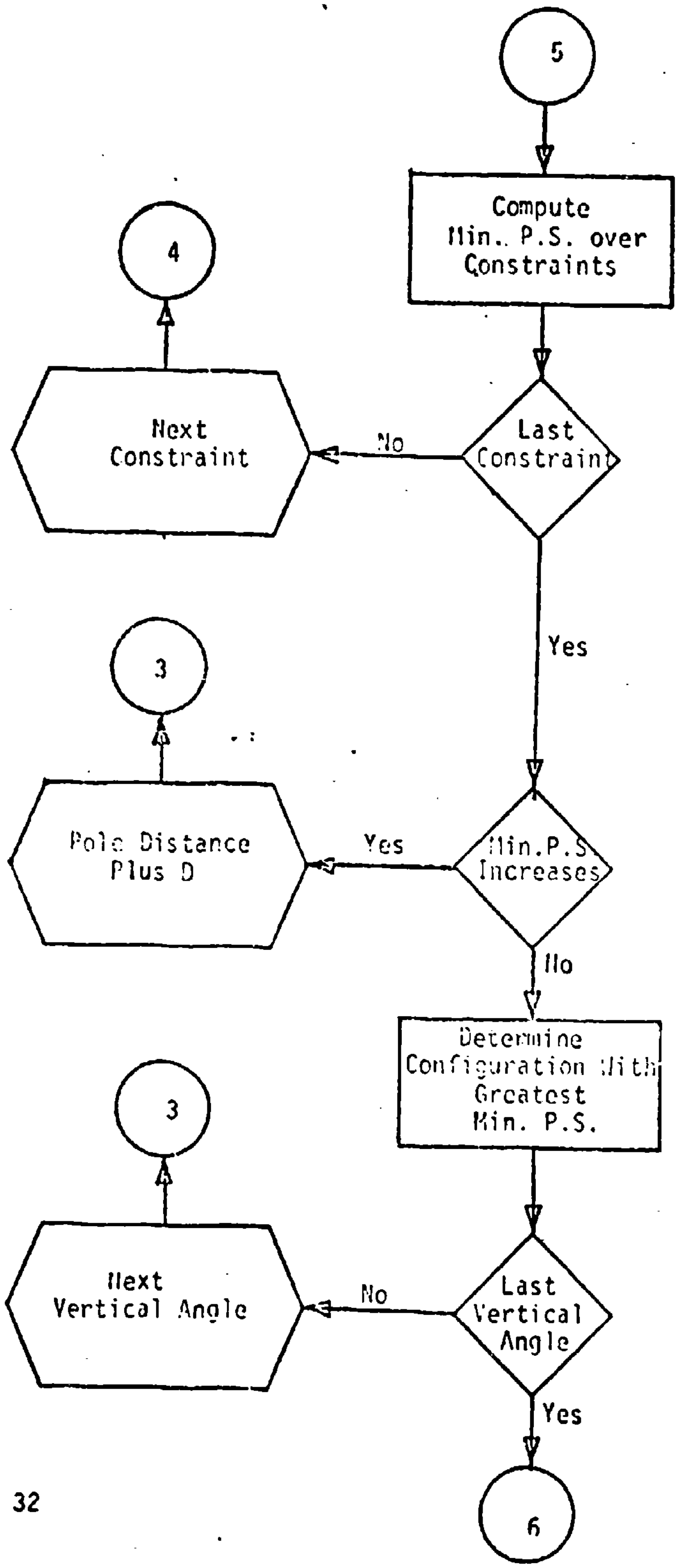
c. A flow diagram (Flow Charts 1a, 1b, and 1c) is given below incorporating the basic assumptions developed in this report, but omitting computational details.

21-34



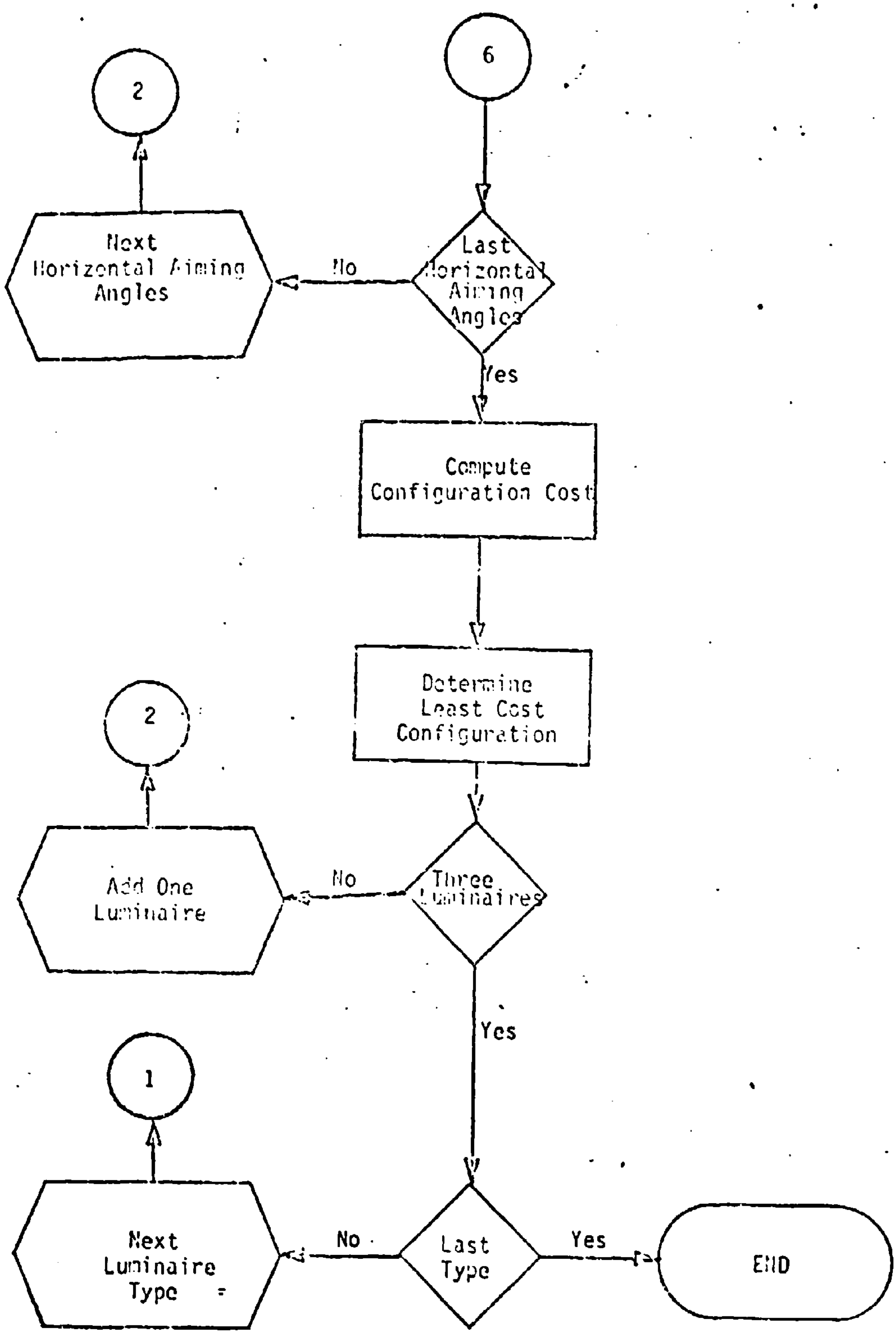
FLOW CHART 1a

21 35



FLOW CHART 1b

21-36



FLOW CHART 1c 21-37

ANNEX A

MATHEMATICAL FORMULATION OF THE PERIMETER LIGHTING PROBLEM

For detailed numerical analysis, the perimeter lighting problem has been reformulated in vector notation. This simplifies the mathematics used in the computer program to investigate the changing of parameters. Points have been located in an x, y, z coordinate system with origin at the base of the pole. The x-axis is parallel to the fence. The y-axis is normal to the plane containing the fence. The z-axis is normal to the ground plane. What this simply means is that pole spacing is measured along the x-axis, distance constraints among the pole, fence and boundary are measured on the y-axis, and height is measured on the z-axis. The following figure will help explain the three axes and the geometric or vector relationships below:

x = 1/2 pole spacing (ft)

y_1 = distance from pole to fence (ft)

y_2 = distance from pole to boundary (ft)

z_o = height of luminaire on pole (ft)

z_1 = height of fence (ft)

z_2 = height of boundary measurement (ft)

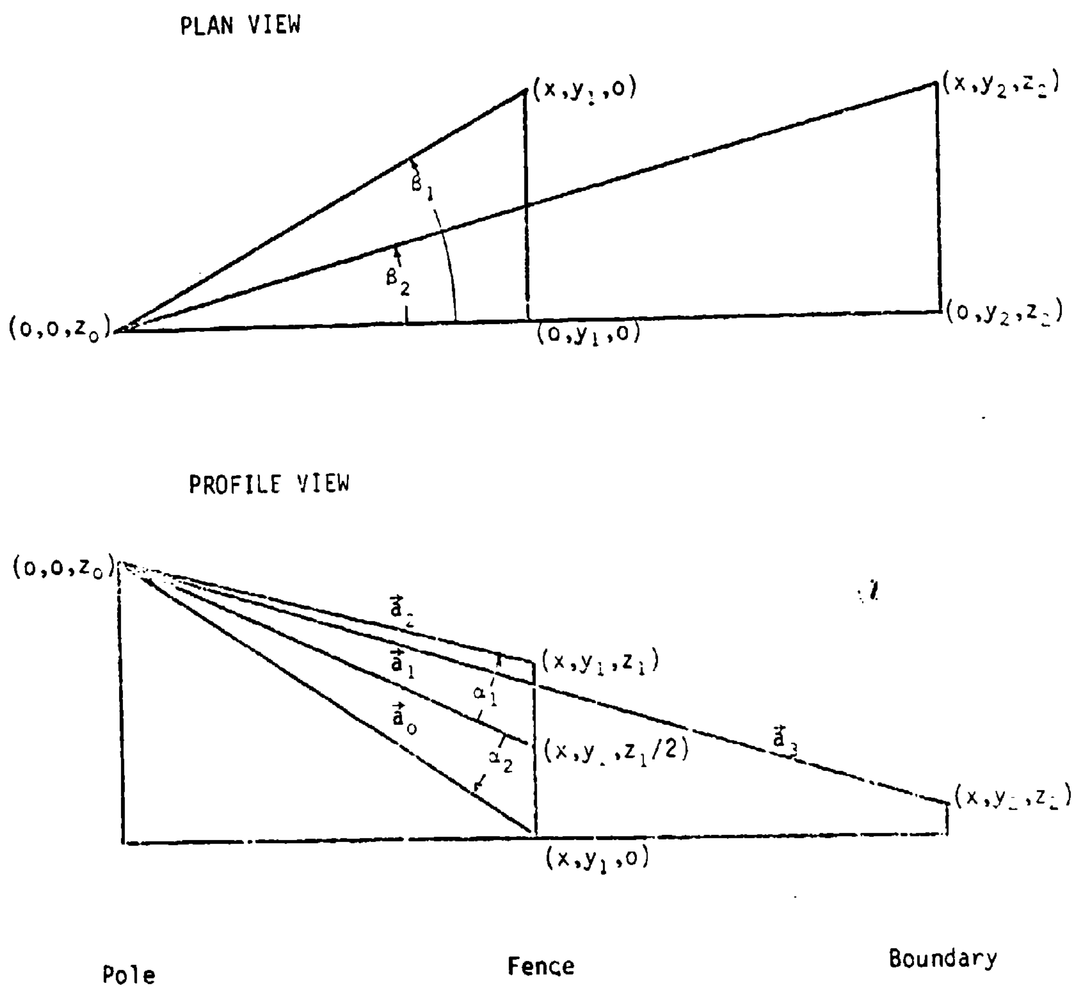


Figure 1. Geometry of the Perimeter Lighting Problem

The following vectors are defined from the luminaire to

POINT 0: Bottom of fence (x ft down fence)

$$\vec{a}_0 = (x, y_1, 0) - (0, 0, z_0) = (x, y_1, -z_0)$$

$$d_0 = |\vec{a}_0| = \sqrt{x^2 + y_1^2 + z_0^2}$$

$$= \sqrt{x^2 + b_0} \quad \text{where} \quad b_0 = y_1^2 + z_0^2$$

POINT 1: Middle of fence (x ft down fence)

$$\vec{a}_1 = (x, y_1, z_1/2) - (0, 0, z_0) = (x, y_1, z_1/2 - z_0)$$

$$d_1 = |\vec{a}_1| = \sqrt{x^2 + y_1^2 + (z_1/2 - z_0)^2}$$

$$= \sqrt{x^2 + b_1} \quad \text{where} \quad b_1 = y_1^2 + (z_1/2 - z_0)^2$$

POINT 2: Top of fence (x ft down fence)

$$\vec{a}_2 = (x, y_1, z_1) - (0, 0, z_0) = (x, y_1, z, -z_0)$$

$$d_2 = |\vec{a}_2| = \sqrt{x^2 + y_1^2 + (z_1 - z_0)^2}$$

$$= \sqrt{x^2 + b_2} \quad \text{where} \quad b_2 = y_1^2 + (z_1 - z_0)^2$$

POINT 3: Boundary (x ft down fence)

$$\vec{a}_3 = (x, y_2, z_2) - (0, 0, z_0) = (x_1, y_2, z_2 - z_0)$$

$$d_3 = |\vec{a}_3| = \sqrt{x^2 + y_2^2 + (z_2 - z_0)^2}$$

$$= \sqrt{x^2 + b_3} \quad \text{where} \quad b_3 = y_2^2 + (z_2 - z_0)^2.$$

The vertical angles α_1 and α_2 can be calculated as follows:

$$\alpha_1 = \cos^{-1}\left(\frac{\vec{a}_1 \cdot \vec{a}_2}{|\vec{a}_1|\,|\vec{a}_2|}\right) = \cos^{-1}\left(\frac{x^2+b_4}{d_1 d_2}\right)$$

where $b_4 = y_1{}^2+(z_1-z_o)(z_1/2-z_o)$

$$\alpha_2 = \cos^{-1}\left(\frac{\vec{a}_o \cdot \vec{a}_1}{|\vec{a}_o|\,|\vec{a}_1|}\right) = \cos^{-1}\left(\frac{x^2+b_5}{d_o d_1}\right)$$

where $b_5 = y_1{}^2-z_o(z_1/2-z_o)$.

The horizontal angles β_1 and β_2 can be calculated as follows:

$$\beta_1 = \cos^{-1}\left(\frac{y_1{}^2+z_o{}^2}{d_o\sqrt{b_o}}\right) = \cos^{-1}\left(\frac{b_o}{d_o\sqrt{b_o}}\right) = \cos^{-1}\left(\frac{\sqrt{b_o}}{d_o}\right)$$

$$\beta_2 = \cos^{-1}\left(\frac{y_2{}^2+(z_2-z_o)^2}{d_3\sqrt{b_3}}\right) = \cos^{-1}\left(\frac{b_3}{d_3\sqrt{b_3}}\right) = \cos^{-1}\left(\frac{\sqrt{b_3}}{d_3}\right)$$

Let V be the vertical aiming angle of the luminaire and let F (h,v) be the interpolated output of the luminaire for a horizontal angle (h) and a vertical angle (v). The incident light at Points 0 through 3 may now be calculated as follows:

$$L_o = F\,(90-\beta_1,\ V-\alpha_2)\left(\frac{1}{d_o{}^2}\right)\left(\frac{y_1}{\sqrt{b_o}}\right)\left(\frac{\sqrt{b_o}}{d_o}\right) = \frac{y_1\ F\,(90-\beta_1,\ V-\alpha_2)}{d_o{}^3}$$

$$L_1 = F\,(90-\beta_1,\ V)\left(\frac{1}{d_1{}^2}\right)\left(\frac{y_1}{\sqrt{b_1}}\right)\left(\frac{\sqrt{b_1}}{d_1}\right) = \frac{y_1\ F\,(90-\beta_1,\ V)}{d_1{}^3}$$

$$L_2 = F\,(90-\beta_1,\ V+\alpha_1)\left(\frac{1}{d_2{}^2}\right)\left(\frac{y_1}{\sqrt{b_2}}\right)\left(\frac{\sqrt{b_2}}{d_2}\right) = \frac{y_1\ F\,(90-\beta_1,\ V+\alpha_1)}{d_2{}^3}$$

$$L_3 = F\,(90-\beta_2,\ V)\left(\frac{1}{d_3{}^2}\right)\left(\frac{y_2}{\sqrt{b_3}}\right)\left(\frac{\sqrt{b_3}}{d_3}\right) = \frac{y_2\ F\,(90-\beta_2,\ V)}{d_3{}^3}$$

Horizontal Correction

Vertical Correction

Distance Correction

ANNEX B

BIVARIATE INTERPOLATION FORMULA

TO OBTAIN F(h,v) FROM TABLE T(H,V)

Let T(H,V) be a bivariate table of luminaire output with H and V being tabulated over the values:

H: 90 to 270 degrees

V: -90 to +90 degrees.

$$\text{Let } r = \frac{h-H_o}{H_1-H_o} \quad \text{where} \quad H_1 < h \leq H_o$$

$$s = \frac{v-V_o}{V_1-V_o} \quad \text{where} \quad V_o < v \leq V_1 \quad .$$

$$F(h,v) = (1-r)(1-s)T(H_o,V_o) + r(1-s)T(H_1,V_o) + (1-r)sT(H_o,V_1) + rsT(H_1,V_1).$$

This formula would yield exact results if F(h,v) were of the form A + Bh + Cv + Dhv.

APPENDIX B

CANDLEPOWER TABLES

LUMINAIRE INDEX
January 1978

	Computer Code	C.P. File No.*	Fixture No.**	Actual Lamp Lumens	PHOTOMETRIC SOURCE DATA			
					I.D. No.	Type***	Test Date	Test Lumens
1.	H90LS65NO1	13	1	12500	-	Isocandela Diagram	Approx. 1974	12500
2.	H90LS75SE1	51	2	12500	-	Isocandela Curves	Approx. 1976	12500
3.	H135L75SE1	50	20	21500	-	Isocandela Curves	Approx. 1976	21500
4.	H180L75SE1	52	3	33000	-	Isocandela Curves	Approx. 1976	33000
5.	H180L76NO1	14	4	33000	-	Isocandela Diagram	Approx. 1974	33000
6.	H250S65WE1	53	21	50000	630743	Lumen Chart	10-13-72	47000
7.	H250S66HU1	58	22	25500	HP-00444	Isocandela/ Lumen Chart	11-21-75	25500
8.	H250S75WE1	27	23	25500	ERL 1832	C.P. Table	5-17-76	25500
9.	H250S76GE1	29	24	25500	35-175448	Isocandela/ Lumen Chart	8-29-72	1000
10.	H250S76WE1	22	25	25500	630386	Isocandela/ Lumen Chart	5-22-69	44000
11.	H300P56WGE	25	302	3840	-	C.P. Curves	Approx. 1966	3840
12.	H300Q65GE1	20	80	5950	35-174254	Prorate of 500w(See#27)	3-17-64	10500
13.	H400S22HU1	28	26	50000	TRH-11162 -29-P	Isocandela/ Lumen Chart	9-16-71	47000
14.	H400S44WE1	46	27	50000	672246	Lumen Chart	6-10-75	47000
15.	H400S55HU1	26	28	50000	TRH-11162 -33-P	Isocandela/ Lumen Chart	9-21-71	47000
16.	H400S55WE1	47	29	50000	672247	Lumen Chart	6-10-75	47000
17.	H400S62SE1	48	30	50000	-	Isocandela Curves	Approx. 1976	50000
18.	H400S64CH1	17	305	50000	4577-A	Isocandela/ Lumen Chart	8-14-74	50000
19.	H400S65SE1	49	31	50000	-	Isocandela Curves	Approx. 1976	50000
20.	H400S65WE1	61	32	50000	630743	Lumen Chart	10-13-72	47000

LUMINAIRE INDEX

January 1978

	Computer Code	C.P. File No.*	Fix-ture No.**	Actual Lamp Lumens	PHOTOMETRIC SOURCE DATA			
					I.D. No.	Type***	Test Date	Test Lumens
21.	H400S67CH1	57	33	50000	45611	C.P. Table (Comp. P.O.)	Approx. 1973	50000
22.	H400S76CH1	44	34	50000	45543	C.P. Table (Comp. P.O.)	Approx. 1973	50000
23.	H400S76GE1	45	35	50000	35-176201	Isocandela/ Lumen Chart	12-15-76	1000
24.	H400S76SY1	21	36	50000	4440	C.P./Lumen Table	6-22-76	50000
25.	H400S76WE1	24	37	50000	630386	Isocandela/ Lumen Chart	5-22-69	44000
26.	H500Q55LA1	66	81	10500	-	Isocandela/ Lumen Chart	Approx. 1967	10500
27.	H500Q65GE2	2	82	10500	35-174254	Isocandela/ Lumen Chart	3-17-64	10500
28.	H10CS65HO1	32	38	140000	27189-P	Isocandela Curves	Approx. 1975	140000
29.	H10CS76CH1	10	39	140000	45803	C.P. Table (Comp. P.O.)	Approx. 1970	130000
30.	H10CS76CH2	16	307	130000	4531-A	Isocandela/ Lumen Chart	11-19-73	130000
31.	H10CS76HU1	15	40	140000	HP-00429	Isocandela/ Lumen Chart	Approx. 1976	140000
32.	H10CS76WI1	54	41	130000	-	Isocandela/ Lumen Chart	-	130000
33.	H15CQ62GE1	40	83	33000	35-174257	Isocandela/ Lumen Chart	4-16-64	33000
34.	H15CQ62GE2	43	84	33000	35-175783	Isocandela/ Lumen Chart	11-13-74	1000
35.	H15CQ64LA1	39	85	33000	-	Isocandela/ Lumen Chart	Approx. 1966	33000
36.	H15CQ64GE1	41	86	33000	35-175784	Isocandela/ Lumen Chart	11-13-74	1000
37.	H15CQ65GE1	42	88	33000	35-175785	Isocandela/ Lumen Chart	11-13-74	1000
38.	H15CQ65CE2	12	89	34400	35-175785	Isocandela/ Lumen Chart	11-13-74	1000
39.	H15CQ65GE3	1	90	34400	5785	C.P. Table (Comp. P.O.)	11-13-74	1000
40.	H15CQ65GE4	62	91	34400	35-175785	Isocandela/ Lumen Chart	11-13-74	1000
41.	H15CQ65HU1	7	92	34400	HP-00392	Isocandela/ Lumen Chart	Approx. 1975	35800
42.	H15CQ65LA1	6	87	34400	-	Isocandela/ Lumen Chart	Approx. 1968	33000

LUMINAIRE INDEX
January 1978

	Computer Code	C.P. File No.*	Fix-ture No.**	Actual Lamp Lumens	PHOTOMETRIC SOURCE DATA			
					I.D. No.	Type***	Test Date	Test Lumens
43.	H15CQ66GE1	23	93	33000	35-174259	Isocandela/ Lumen Chart	3-17-64	33000
44.	H20MX76AD1	19	308	500000	ERL 1563	C.P./Lumen Table	11-6-75	500000
45.	V35WL4MN01	8	300	4800	ERL 2080	C.P. Table	1-18-77	4800
46.	V55WL4SN01	9	301	8000	ERL2081A	C.P. Table	1-17-77	8000
47.	V150S3MGE1	38	120	16000	5693	C.P. Table (Comp. P.O.)	3-21-77	100000
48.	V150S4LLA1	11	303	16000	JB-6	C.P. Table	9-16-77	16000
49.	V180L4SAE1	4	103	33000	ERL 1924	C.P. Table	9-16-76	33000
50.	V180L4MAE1	67	100	33000	ERL 1933	C.P. Table	9-14-76	33000
51.	V180L4MAE2	5	101	33000	ERL 1934	C.P. Table	9-17-76	33000
52.	V180L4MLU1	65	102	33000	2634	Isocandela Diagram	Approx. 1975	33000
53.	V180L4SQU1	64	104	32000	17218	C.P. Table (Comp. P.O.)	1-24-74	32000
54.	V180L4SQU2	68	105	33000	17218	C.P. Table (Comp. P.O.)	1-24-74	32000
55.	V180LGWVL1	55	304	33000	429986	Lumen Chart	11-14-74	7700(55W)
56.	V250S3MAE1	3	121	25500	25-37	Isocandela Diagram	10-14-75	25500
57.	V250S3MGE1	63	122	25500	5819	C.P. Table (Comp. P.O.)	3-21-77	100000
58.	V250S3MGE2	33	123	25500	35-175135	Isocandela Diagram	4-28-70	25000
59.	V250S3MWE1	35	124	25500	672303	Isocandela Diagram	12-6-74	1000
60.	V250S4MWE1	34	126	25500	672316	Isocandela Diagram	12-23-74	1000
61.	V250S4LAE1	60	125	25500	I-2351	C.P. Table (Comp. P.O.)	Approx. 10-1-75	25500
62.	V400S2SGE1	30	127	(Test Luminaire-C.P. Table obtained from Alabama Highway Department)				
63.	V400S3MGE1	37	128	50000	5819	C.P. Table (Comp. P.O.)	3-21-77	100000

LUMINAIRE INDEX
January 1978

	Computer Code	C.P. File No.*	Fix-ture No.**	Actual Lamp Lumens	PHOTOMETRIC SOURCE DATA			
					I.D. No.	Type***	Test Date	Test Lumens
64.	V400S4LAE1	56	129	50000	I-2350	C.P. Table (Comp. P.O.)	Approx. 10-1-75	50000
65.	V400S4MWE1	36	130	50000	672241	Isocandela Diagram	1-4-74	1000
66.	V10CS5MGE1	31	306	130000	35-175227	C.P. Graph	3-16-73	130000
67.	V10CS65H01	59	42	140000	27189-P	C.P. Table (Comp. P.O.)	Approx. 1975	140000
68.	V10CS76CH1	18	43	140000	45803	C.P. Table (Comp. P.O.)	Approx. 1970	130000

* The Candlepower File Number identifies the Corps of Engineers data file (computer printout) associated with a specific luminaire. (See p. B14)

** See "LUMINAIRE IDENTIFICATION GUIDE".

*** C.P. = Candlepower
P.O. = Printout
Comp. = Computer

NOTES:

1. The computer codes are in general alphanumeric order; wattage symbols appear in the order of the wattage represented rather than strict numeral order (i.e. "V55W..." before "V150..." and "H10C..." after H500...").

2. All manipulations involving these luminaires must be referenced from the photometric test position. Floodlights are normally positioned with the lens face 90° from the aiming vector (i.e. normal to it) per sheet 1 of Figure 23. A floodlight tested by the VPA format (no. 67) will have the plane of the lens positioned at 0°. In this position the plane of the lens is normal to the vertical aiming reference vector. See Sheet 3 of Figure 23. The beam axis of the General Electric Versaflood I (#9) is positioned 25° above the candlepower test axis (lens 115° from test axis). The longitudinal axis of the Interstate luminaires (Nos. 61 and 64) is tilted 30° from the horizontal aiming reference vector (sheet 3 of Figure 23).

KEY TO LUMINAIRE COMPUTER CODES

Sample Codes	H	15C	Q	75	GE	2
	V	180	L	4M	AE	1
Position --	A	B	C	D	E	F

Position A: Photometric Test Format. Use "H" for horizontal polar axis, "V" for vertical polar axis.

Position B: Nominal wattage. "C" is equivalent to "00", "M" to "000". The "W" (used in a few codes) represents watts.

Position C: Type of Source. "Q" indicates quartz iodine, "I" incandescent "F" fluorescent, "M" mercury vapor, "H" metal halide, "S" high pressure sodium, "L" low pressure sodium and "X" long arc xenon. An exception is "90LS" (pos. A and B combined) which denotes 90 watt low pressure sodium.

Position D: Beam distribution type: A numeral pair such as "65" refers to a NEMA Type 6x5 floodlight beam. A numeral-letter combination signifies an IES type of distribution pattern - i.e. "3M" is used for a unit having an IES Type III, medium, semicutoff distribution.

Position E: Manufacturer. "AE" is shorthand for American Electric Div. of ITT, "HO" for Holophane Lighting, "AD" for American Daylight Co, etc.

Position F: Differentiation Symbol. The numeral "1" signifies the particular luminaire was the first of that type to have photometric data entered into the computer data storage file. If data for an upgraded model, or different test data for the same unit is entered, the next consecutive numeral (or letter) is used.

LUMINAIRE IDENTIFICATION GUIDE
January 1978

No.	Computer Code	Manufacturer / Catalog No. / Socket Position	Fixture Type*/Model No. / Wattage and Lamp Type/Lamp No. / Light Distribution Category
		A. FLOODLIGHTS (1-99)	
	Low Pressure Sodium (1-19)		
1.	H90LS65NO1 (H90LS65NO) (H90HS65NO)	Norelco 09302 -	Rectangular Flood/SNF-026 90W. L.P.S./SOX90 NEMA 6x5 (120°Hx100°V)
2.	H90LS75SE1 (H90LS75SE)	Sepco Floodlighting 4000-90 NA	Rectang. Flood/Series 4000 90W. L.P.S./SOX90 NEMA 7x5 (140°Hx90°V)
3.	H180L75SE1 (H180LS75SE)	Sepco Floodlighting 4000-180 NA	Rectang. Flood/Series 4000 180W. L.P.S./SOX180 NEMA 7x5 (150°Hx90°V)
4.	H180L76NO1 (H180LS76NO) (H180HS76NO)	Norelco 09304 -	Rectang. Flood/SNF-027 180 W. L.P.S./SOX180 NEMA 7x6 (140°Hx110°V)

LUMINAIRE IDENTIFICATION GUIDE
January 1978

No.	Computer Code	Manufacturer / Catalog No. / Socket Position	Fixture Type*/Model No. / Wattage and Lamp Type/Lamp No. / Light Distribution Category
	High Pressure Sodium (20-49)		
20.	H135L75SE1 (H135LS75SE)	Sepco Floodlighting 4000-135 NA	Rectangular Flood/Series 4000 135W. H.P.S./SOX135 NEMA 7x5 (144°Hx90°V)
21.	H250S65WE1 (H250HS65WE)	Westinghouse R4G-SNGE-65A NA	Rectangular Flood/MRF-250 250W. H.P.S./C250 NEMA 6x5 (129.6°Hx99.0°V)
22.	H250S66HU1 (H250HS66HU)	Hubbell MGS-0250S-624 NA	Circular Flood/Magnuliter II 250W. H.P.S./LU250/BD NEMA 6x6 (127.9°Hx112.0°V)
23.	H250S75WE1 (H250HS75WE)	Westinghouse R4G-SNGE-75A-277 NA	Rectangular Flood/MRF 250 250W. H.P.S./C250 NEMA 7x5 (130.8°Hx90.6°V)
24.	H250S76GE1 (H250HS76GE)	General Electric C875G504 3	Asymmetric Flood/Versaflood I Luminaire 250 W. H.P.S./LU250/BD NEMA 7x6 (139°Hx120°V)
25.	H250S76WE1 (H250HS76WE)	Westinghouse R4G-SNGE-76A-277 NA	Rectangular Flood/MRF 250 250W. H.P.S./C250 NEMA 7x6 (144°Hx109°V)
26.	H400S22HU1 (H400HS22HU)	Hubbell 3245-277HS NA	Circular Flood/Marinelite Series 3000 400W. H.P.S./LU400/BD NEMA 2x2 (24.5°Hx23.5°V)
27.	H400S44WE1 (H400HS44WE)	Westinghouse DHG-SPGE-44A-277 NA	Circular Flood/DL-400 400W. H.P.S./C400 NEMA 4x4 (54.2°Hx54°V)
28.	H400S55HU1 (H400HS55HU)	Hubbell 3545-277HS NA	Circular Flood/Marinelite Series 3000 400W. H.P.S./LU400/BD NEMA 5x5 (90°Hx86.5°V)
29.	H400S55WE1 (H400HS55WE)	Westinghouse DHG-SPGE-55A-277 NA	Circular Flood/DL-400 400 W. H.P.S./C400 NEMA 5x5 (86.1°Hx86.2°V)
30.	H400S62SE1 (H400HS62SE)	Sepco Floodlighting 7000-990-400HPS NA	Rectangular Flood/Series 7000 400W. H.P.S./LU400/BU NEMA 6x2 (105°Hx23°V)
31.	H400S65SE1 (H400HS65SE)	Sepco Floodlighting 7000-90120-400HPS NA	Rect. Flood/Series 7000 400W. H.P.S./LU400/BD NEMA 6x5 (120°Hx90°V)

LUMINAIRE IDENTIFICATION GUIDE
January 1978

No.	Computer Code	Manufacturer / Catalog No. / Socket Position	Fixture Type*/Model No. / Wattage and Lamp Type/Lamp No. / Light Distribution Category
32.	H400S65WE1 (H400HS65WE) (H400HS76WE)	Westinghouse R4G-SPGE-65A-277 NA	Rectangular Flood/MRF 400 400W. H.P.S./C400 NEMA 6x5 (129.6°Hx99.0°V)
33.	H400S67CH1 (H400HS67CH)	Crouse-Hinds 48334 NA	Rectangular Flood/MV/MA Series 400W. H.P.S./C400 NEMA 6x7 (125°Hx142°V)
34.	H400S76CH1 (H400SGRCH1)	Crouse-Hinds GALR-4LEC7 NA	Asymmetric Flood/GAL Series 400W. H.P.S./LU400/BU NEMA 7x6
35.	H400S76GE1	General Electric C539G507 B-2	Rectangular Flood/P400C 400W. H.P.S./LU400/BD NEMA 7x6 (144°Hx112°V)
36.	H400S76SY1 (H400HS76SY)	Sylvania HDF400-561 NA	Rectangular Flood/Batwing Series 400W. H.P.S./LU-400 NEMA 7x6 (137.3°Hx101.4°V)
37.	H400S76WE1 (H400HS76WE)	Westinghouse R4G-SPGE-76A-277 NA	Rectangular Flood/MRF 400 400W. H.P.S./C400 NEMA 7x6 (144°Hx109°V)
38.	H10CS65HO1 (H10CHS65HO) (HS1000WMHO)	Holophane 855-277 NA	Same as No. 42 but with C.P. data in Horizontal Polar Axis (HPA) format.
39.	H10CS76CH1 (HPS1000RCH)	Crouse Hinds GALR-10LEC7 NA	Asymmetric Flood/GAL Series 1000W. H.P.S./LU1000 NEMA 7x6
40.	H10CS76HU1 (H10CHS76HU) (HS1000WHHU)	Hubbell MGL-1000S-614 1	Rectangular Flood/Magnuliter II 1000W. H.P.S./LU1000/BD NEMA 7x6 (137.1°Hx123.9°V)
41.	H10CS76WI1 (H10CHS76WI)	Wide-Lite F-1001-DWRB-EX NA	Rectangular Flood/F Series 1000 W. H.P.S./LU1000/BD NEMA 7x6 (140°Hx127°V)
42.	V10CS65HO1 (V10CHS65HO)	Holophane 855-277 NA	Cylindrical Flood/Vectorflood 1000W. H.P.S./LU1000 NEMA 6x5 (113°Hx76°V)
43.	V10CS76CH1 (V10CHSGRCH)	Crouse Hinds GALR-10LEC7 NA	Same as No. 39 but with C.P. data in Vertical Polar Axis (VPA) format.

LUMINAIRE IDENTIFICATION GUIDE
January 1978

No.	Computer Code	Manufacturer / Catalog No. / Socket Position	Fixture Type*/Model No. / Wattage and Lamp Type/Lamp No. / Light Distribution Category
	Quartz (80-99)		
80.	H300Q65GE1 (H300Q65GE)	General Electric C524G006 NA	Rectangular Flood/QF-500A 300W. Quartz/Q300T3/CL NEMA 6x5 (100°Hx93°V)
81.	H500Q55LA1 (H500Q65LA1) (H500Q65LA)	Landmark Lighting TA063 NA	Rectangular Flood/TA 500 Watt Series 500W. Quartz/Q500T3/CL NEMA 6x5 (98°Hx86°V)
82.	H500065GE2 (H500Q65GE1) (H500Q65GE)	General ELectric C524G006 NA	Rectangular Flood/QF-500A 500W. Quartz/Q500T3/CL NEMA 6x5 (100°Hx93°V)
83.	H15CQ62GE1 (H1500Q62GE)	General Electric C525G005 NA	Rectangular Flood/QF-1500A 1500W. Quartz/Q1500T3/CL NEMA 6x2 (120°Hx27°V)
84.	H15CQ62GE2	General Electric C525G004 NA	Rectangular Flood/QF-1500A 1500W. Quartz/Q1500T3/CL NEMA 6x2 (109°Hx23°V)
85.	H15CQ64LA1 (H1500Q64L)	Landmark Lighting TE041 NA	Rectangular Flood/TE 1500 Watt Series 1500W. Quartz/Q1500T3/CL NEMA 6x4 (118°Hx54°V)
86.	H15CQ64GE1	General Electric C525G005 NA	Rectangular Flood/QF-1500A 1500W. Quartz/Q1500T3/CL NEMA 6x4 (118°Hx48°V)
87.	H15CQ65LA1 (H1500Q65L)	Landmark Lighting TE061 NA	Rectangular Flood/TE 1500 Watt Series 1500W. Quartz/Q1500T3/CL NEMA 6x5 (119°Hx99°V)
88.	H15CQ65GE1	General Electric C525G006 NA	Rectangular Flood/QF-1500A 1500W. Quartz/Q1500T3/CL NEMA 6x5 (121°Hx96°V)
89.	H15CQ65GE2	General Electric C525G006 NA	Same as Fixture No. 88 see Luminaire Index
90.	H15CQ65GE3	General ELectric C525G006 NA	Same as Fixture No. 88 see Luminaire Index
91.	H15CQ65GE4	General Electric C525G006 NA	Same as Fixture No. 88 see Luminaire Index
92.	H15CQ65HU1	Hubbell 5505-G NA	Rectangular Flood/Quartzliter Series 6000 1500W. Quartz/Q1500T3/CL NEMA 6x5 (120.9°Hx80°V)

LUMINAIRE IDENTIFICATION GUIDE
January 1978

No.	Computer Code	Manufacturer / Catalog No. / Socket Position	Fixture Type*/Model No. / Wattage and Lamp Type/Lamp No. / Light Distribution Category
93.	H15CQ66GE1 (H1500Q66GE)	General Electric C525G006 NA	Rectangular Flood/QF-1500A 1500W. Quartz/Q1500T3/CL NEMA 6x6 (122°Hx100°V)

* For rectangular floodlights, the lamp axis is parallel to the lense, in either a vertical or horizontal position. (For quartz-iodine floodlights the horizontal position is standard.) Circular or oval floodlights have the lamp axis oriented perpendicular to the lense. For roadway luminaires, the lamp axis lies in the vertical plane that would bisect the unit longitudinally; its position is horizontal or nearly horizontal.

LUMINAIRE IDENTIFICATION GUIDE
January 1978

No.	Computer Code	Manufacturer / Catalog No. / Socket Position	Fixture Type*/Model No. / Wattage and Lamp Type/Lamp No. / Light Distribution Category
		B. ROADWAY (100-199)	
	Low Pressure Sodium (100-119)		
100.	V180L4MAE1	American Electric 66-88H4-6 Center	Roadway/Series 66 180W. L.P.S./SOX180 IES Type IV, Medium, Noncutoff
101.	V180L4MAE2	American Electric 66-88H4-6 Lower	Roadway/Series 66 180W. L.P.S./SOX180 IES Type IV, Medium, Noncutoff
102.	V180L4MLU1	Lustra Lighting SRP-252-277 I	Roadway/SRP 252 180W. L.P.S./SOX180 IES Type IV, Medium, Cutoff
103.	V180L4SAE1	American Electric 66-884-6 Upper	Roadway/Series 66 180W. L.P.S./SOX180 IES Type IV, Short, Noncutoff
104.	V180L4SQU1	Quality Outdoor Ltg. 9754-27 -	Roadway/Series 9752-9754 180W. L.P.S./SOX180 IES Type IV, Short, Cutoff

LUMINAIRE IDENTIFICATION GUIDE
January 1978

No.	Computer Code	Manufacturer / Catalog No. / Socket Position	Fixture Type*/Model No. / Wattage and Lamp Type/Lamp No. / Light Distribution Category
	High Pressure Sodium (120-149)		
120.	V150S3MGE1	General Electric C728G550-OP4 1	Std. Roadway/M-250A POWR/DOOR 150W. H.P.S./LU150 IES Type III, Medium, Cutoff
121.	V250S3MAE1	American Electric(ITT) 26-6533 3W/SP.A	Std. Roadway/American "400" 250W. H.P.S./LU150 IES Type III, Medium, Semicutoff
122.	V250S3MGE1 (V250S3MGE)	General Electric C724-G-797-OP3(277) 6	Std. Roadway/M-400A POWR/DOOR 250W. H.P.S./LU250 IES Type III, Medium, Semicutoff
123.	V250S3MGE2 (V250HS3SGE)	General ELectric C724G574-277 2	Std. Roadway/M400A 250W. H.P.S./LU250 IES Type III, Medium, Noncutoff
124.	V250S3MWE1	Westinghouse TIG-SNGD-3EA M-A	Std. Roadway/Tudor, OV15 250W. H.P.S/C250 IES Type III, Medium, Semicutoff
125.	V250S4LAE1 (V250HSRLAE)	American Electric(ITT) 186-6536 -	Deep Setback Roadway/Interstate 250W. H.P.S./LU250 IES Type IV, Wide distribution
126.	V250S4MWE1	Westinghouse T2G-SNGD-4EA #7-M-A	Std. Roadway/Tudor, OV-25 250W. H.P.S./C250 IES Type IV, Medium, Semicutoff
127.	V400S2SGE1 (V400HS2SGE)	General Electric (Test Luminaire) -	Standard Roadway 400W. H.P.S./LU400 IES Type II
128.	V400S3MGE1	General Electric C724G564-OP3(277) 6	Std. Roadway/M-400A POWR/DOOR 400W. H.P.S./LU400 IES Type III, Medium, Semicutoff
129.	V400S4LAE1 (V400HSGLAE)	American Electric(ITT) 186-6546 -	Deep Set-Back Roadway/Interstate 400W. H.P.S./LU400 IES Type IV, Wide distribution
130.	V400S4MWE1	Westinghouse V2G-SPGD-4EA #M-A	Std. Roadway/OV-25 400W. H.P.S./C400 IES Type IV, Medium, Noncutoff

LUMINAIRE IDENTIFICATION GUIDE
January 1978

No.	Computer Code	Manufacturer / Catalog No. / Socket Position	Fixture Type*/Model No. / Wattage and Lamp Type/Lamp No. / Light Distribution Category
		C. MISCELLANEOUS (300-399)	
300.	V35WL4MN01	Norelco 33825 -	Wall Mounted Unit/SWP-465 35W. Low Pressure Sodium/SOX35 IES Type IV
301.	V55WL4SN01	Norelco 33826 -	Wall Mounted Unit/SWP-465 55W. Low Pressure Sodium/SOX55 IES Type IV
302.	H300P56WGE	GE#300PAR56-WFL (Hubbell Lampholder #S-400) NA	PAR Lampholder 300W. PAR/300 PAR56-WFL Wide Beam (60°Hx30°V)
303.	V150S4LLA1	Landmark Lighting JB-57061 Center	Wall Mounted Unit/Series 82 150W. H.P.S./LU150/BU IES Type IV
304.	V180LGWVL1	Voight Lighting Ind. 0-18 Center	Architectural Roadway/General 180W. Low Pressure Sodium/SOX180 General Roadway
305.	H400S64CH1 (H400HS75CH)	Crouse-Hinds 1123-400 NA	Oval Floodlight/Series 1100 400W. H.P.S./LU400/BU NEMA 6x4 (128.5°Hx48.9°V)
306.	V10CS5MGE1 (V10CHS6GE)	General Electric C741G044 1	High Mast/HM-1000 Symmetrical Luminaire 1000 W. H.P.S./LU1000/BU IES Type IV
307.	H10CS76CH2 (H10CHS76CH) (HS1000WHCH)	Crouse Hinds 1123-1000 NA	H.P.S. Floodlight/Series 1100 1000W. H.P.S./LU1000/BU NEMA 7x6 (157.6°Hx122.2°V)
308.	H20MX76AD1 (H20MXE76AD)	American Daylight Co. ADC-20 NA	High Intensity Floodlight 20,000W. Xenon Lamp very wide beam NEMA 7x6 (176.2°Hx121.2°V)

CANDLEPROBE TABLE PRINTOUT

NO.	LUMI	NO.	LUMI	NO.	LUMI	NO.	LUMI
1	H150265GE3	2	H500 65GE2	3	V250S3MAE1	4	V180L4SAE1
5	V180L4MAE2	6	H150 65LA1	7	H150 55H01	8	V350L4MN01
9	V550L4SN01	10	H100S76CH1	11	V150S4LLA1	12	H150 65GE2
13	H900S65N01	14	H180 76N01	15	H100S76H01	16	H100S76CH2
17	H400S64CH1	18	V100S76CH1	19	H200S76[illegible]01	20	H300 55GE1
21	H400S76SY1	22	H250S76GE1	23	H150 55GE1	24	H400S76WE1
25	H300S56VGE	26	H400S65H01	27	H250S75GE1	28	H400S24H01
29	H250S76GE1	30	V400S2SGE1	31	V1[illegible]GE1	32	H100S65H01
33	V250S3[illegible]GE2	34	V250S4[illegible]F1	35	V250S3[illegible]E1	36	V400S4MWE1
37	V400S3[illegible]GE1	38	V150S3WGE1	39	H150S4[illegible]1	40	H150 62GE1
41	H150 54GE1	42	H150 55GE1	43	H150 52GE2	44	H400S76CH1
45	H400S76GE1	46	H400S44[illegible]E1	47	H400S55SE1	48	H400S62SE1
49	H400S65SE1	50	H135S75SE1	51	H400S75SE1	52	H100L75SE1
53	H250S65WE1	54	H100S76NI1	55	V180L5WVL1	56	V400S4LAE1
57	H400S67CH1	58	H250S66H01	59	V100S55H01	60	V250S4LAE1
61	H400S55WE1	62	H150 55GE4	63	V250S3[illegible]E1	64	V150L45H01
65	V180L4[illegible]L01	66	H500 56LE1	67	V180L4[illegible]E1	68	V150L45H02

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible]
GE PHOTO CURVE 578[illegible] 11/02/77
CANDLEPOWER CONSTANT =.70352000

HORZ. ANGLES (H 19 19)

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	90.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
-68.0	0	0	57	114	171	228	285	285	342	342	342	285	285	228	171	114	57	0	0
-60.0	57	57	114	171	228	285	342	342	399	399	399	342	342	285	228	171	114	57	57
-52.0	57	114	171	228	285	342	399	399	456	456	456	399	399	342	285	228	171	114	57
-44.0	143	542	1426	2481	3422	3793	4363	4078	4306	4563	4306	4078	4363	3793	3422	2481	1426	542	143
-36.0	257	970	2224	3422	4534	4848	5532	5247	5551	5818	5551	5247	5532	4848	4534	3422	2224	970	257
-28.0	399	1369	2994	4791	6617	6531	7386	7072	7586	7871	7586	7072	7386	6531	6617	4791	2994	1369	399
-20.0	513	1711	4049	6473	8242	9297	10466	10352	10808	11179	10808	10352	10466	9297	8242	6473	4049	1711	513
-12.0	485	1996	5019	8470	11493	13546	15457	15371	16355	16483	16355	15371	15457	13546	11493	8470	5019	1996	485
-4.0	570	2538	6588	14455	15441	18844	21844	21730	22643	23327	22643	21730	21844	18844	15441	14455	6588	2538	570
0.0	627	2624	7215	12377	16654	20305	23470	23356	24268	24981	24268	23356	23470	20305	16654	12377	7215	2624	627
4.0	513	2395	6589	11351	15742	18879	21787	21902	22985	23670	22985	21902	21787	18879	15742	11351	6589	2395	513
12.0	513	2167	5475	9926	14401	13474	15970	15470	16569	16996	16569	15970	15470	13474	14401	9926	5475	2167	513
20.0	456	1711	4079	6616	8555	9616	10865	10723	11122	11464	11122	10723	10865	9616	8555	6616	4079	1711	456
28.0	371	1426	3118	4434	6138	6747	7757	7472	7871	8156	7871	7472	7757	6747	6138	4434	3118	1426	371

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H15C0655E3 TABLE NO. 1
GE PHOTO CURVE 5765 11/02/77
CANDLEPOWER CONSTANT 5.70352000

HORZ. ANGLES (H 1- 19)

VERT.										
		22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0
	90.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	156.0
36.0		257	1027	2167	3593	4648	4991	5732	5390	5732
	6046	5732	5390	5732	4991	4648	3593	2167	1027	257
44.0		171	542	1483	2538	3522	3850	4477	4164	4107
	3992	4107	4164	4477	3850	3522	2538	1483	542	171
52.0		57	114	171	228	285	342	399	399	456
	513	456	399	399	342	285	228	171	114	57
60.0		57	57	114	171	228	285	342	342	399
	456	399	342	342	285	228	171	114	57	57
68.0		0	0	57	114	171	228	285	285	342
	399	342	285	285	228	171	114	57	0	0

816

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H500U553E2 TABLE NO. 2
GE PHOTO CURVE 4254 11/30/77
CANDLEPOWER CONSTANT 15.75898634

HORZ. ANGLES (H 15 15)

VERT.	38.0	46.0	54.0	62.0	70.0	78.0	86.0	90.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0
-52.0	0	0	158	158	158	158	158	158	158	158	158	158	158	0	0
-44.0	158	158	631	946	1104	1262	1262	1262	1262	1262	1104	946	631	158	158
-36.0	158	552	1104	1340	1498	1656	1656	1735	1656	1656	1498	1340	1104	552	158
-28.0	315	867	1419	1892	2208	2602	2681	2838	2681	2602	2208	1892	1419	867	315
-20.0	473	1104	1971	2602	3075	3627	3863	4100	3863	3627	3075	2602	1971	1104	473
-12.0	473	1340	2444	3469	4336	5125	5598	5835	5598	5125	4336	3469	2444	1340	473
-4.0	631	1577	3233	4652	5835	7175	7648	7884	7648	7175	5835	4652	3233	1577	631
0.0	631	1735	3548	5204	6544	7806	8042	8358	8042	7806	6544	5204	3548	1735	631
4.0	552	1498	3233	4731	5992	7175	7569	7884	7569	7175	5992	4731	3233	1498	552
12.0	473	1340	2602	3627	4494	5283	5598	5992	5598	5283	4494	3627	2602	1340	473
20.0	473	1183	1892	2523	3390	3863	4258	4415	4258	3863	3390	2523	1892	1183	473
28.0	394	867	1498	1971	2365	2681	2838	2996	2838	2681	2365	1971	1498	867	394
36.0	237	710	1104	1498	1656	1813	1892	2050	1892	1813	1656	1498	1104	710	237
44.0	158	315	631	946	1183	1262	1262	1419	1262	1262	1183	946	631	315	158

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CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H500055GE2 TABLE NO.   2
GE PHOTO CURVE 4254 11/30/77
CANDLEPOWER CONSTANT     15.76998634

HORZ. ANGLES  (H    15    15)
              38.0  46.0  54.0  62.0  70.0  78.0  86.0  90.0  94.0
  102.0 110.0 118.0 126.0 134.0 142.0
VERT.

 52.0           0      0    158    158    158    158    158    158    158
      158    158    158    158      0      0
```

B12

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V250S3MAE1 TABLE NO. 3

HORZ. ANGLES (V 39 14)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
0.0		300	450	500	540	460	320	300	120	20
	0	0	0	20	120	300	320	450	540	500
	450	300	80	0	0	0	0	0	40	250
	250	40	0	0	0	0	0	60	300	450
5.0		480	600	970	850	633	500	500	420	230
	140	130	140	240	420	500	500	533	850	970
	600	480	230	70	20	0	0	0	100	630
	630	100	0	0	0	20	70	230	480	600
10.0		635	1060	2230	4250	1700	650	640	660	430
	390	360	390	430	660	640	650	1700	4250	2230
	1060	635	360	210	100	50	0	0	95	640
	640	95	0	0	50	100	210	390	635	1060
15.0		1100	3700	6780	9700	4250	1600	1060	950	800
	650	640	650	800	950	1060	1600	4250	9700	6780
	3700	1100	620	490	325	125	90	80	90	620
	620	90	80	90	125	325	490	620	1100	3700
20.0		3825	8000	10500	9750	2660	2250	1700	1140	1140
	1160	1160	1160	1140	1190	1700	2250	2660	9750	10500
	8000	3825	960	638	430	375	230	200	200	500
	500	200	200	230	375	430	638	960	3825	8000
25.0		6760	9750	9720	8200	5780	3900	2600	2130	2220
	2260	2230	2260	2220	2130	2600	3900	5780	8200	9720
	9750	6760	2000	1120	900	630	460	420	420	475
	475	420	420	460	630	900	1120	2000	6760	9750
30.0		6050	7800	7100	6200	5720	5150	2800	3450	4000
	4300	4100	4300	4000	3450	2800	5150	5720	6200	7100
	7800	6050	3900	1950	1280	980	625	560	645	500
	500	645	560	625	980	1280	1950	3900	6050	7800
35.0		5520	6050	6050	5800	6250	5700	4950	5100	5400
	6300	6200	6300	5400	5100	4950	5700	6250	5800	6050
	6050	5520	5200	3300	2100	1600	1150	920	900	800
	800	900	920	1150	1600	2100	3300	5200	5520	6050

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V25)53MAE1 TABLE NO. 3

HORZ. ANGLES (V 3? 14)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
45.0		5000	5200	6600	5950	6350	5300	5720	5900	6500
	7100	6700	7100	6600	5900	5720	5300	6350	5950	6500
	5200	5000	4900	4500	3150	2750	2000	1450	1350	1400
	1400	1350	1450	2000	2750	3150	4500	4900	5000	5200
55.0		4900	5110	5040	5130	5400	5130	5170	5800	6400
	6300	6400	6300	6600	5800	5170	5130	5400	5130	5040
	5110	4900	4700	4450	3600	3250	2750	2225	1910	1950
	1950	1910	2225	2750	3250	3600	4450	4700	4900	5110
65.0		4770	4820	4810	4900	4450	4940	5110	5060	5100
	5300	5200	5300	5100	5060	5110	4940	4450	4900	4810
	4820	4770	4600	4200	3650	3650	3400	2550	2500	2570
	2570	2500	2550	3400	3650	3650	4200	4600	4770	4820
75.0		4600	4500	4570	4700	4990	5100	5600	5130	4650
	4800	4770	4800	4650	5130	5600	5100	4990	4700	4570
	4500	4500	4500	4200	3950	3780	3580	3400	3350	3500
	3500	3350	3400	3580	3780	3950	4200	4500	4600	4500
85.0		4200	4200	4350	4500	4650	4800	4700	4500	4300
	4210	4250	4210	4300	4500	4700	4800	4650	4500	4350
	4200	4200	4200	4100	3910	3900	3800	3760	3750	3790
	3790	3750	3760	3800	3900	3910	4100	4200	4200	4200
90.0		4000	4000	4000	4000	4000	4000	4000	4000	4000
	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V1A0L4SAE1 TABLE NO. 4

HORZ. ANGLES (V 3- 13)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
VERT.										
0.0		251	372	570	743	1139	1615	1827	1515	529
	180	148	180	529	1515	1827	1615	1139	743	570
	372	251	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	251	372
5.0		630	1112	1548	2036	2564	2768	2745	1909	700
	376	341	376	700	1909	2745	2768	2564	2035	1548
	1112	630	433	329	0	0	0	0	0	0
	0	0	0	0	0	0	329	433	630	1112
10.0		1827	2435	3128	3635	3764	4048	3535	1939	1020
	676	644	676	1020	1939	3535	4048	3764	3635	3128
	2435	1827	1305	957	683	493	358	244	117	17
	17	117	244	358	493	683	957	1305	1827	2435
15.0		3692	3951	4374	4732	5167	5068	3551	2178	1345
	947	870	947	1345	2178	3551	5068	5167	4732	4374
	3951	3692	3094	2593	2179	1770	1445	984	521	62
	62	521	984	1445	1770	2179	2593	3094	3692	3951
20.0		4628	5110	5659	5968	5783	4906	3470	2479	1720
	1184	1100	1164	1720	2479	3470	4906	5783	5968	5659
	5110	4628	4198	3946	3530	3040	2576	1867	790	246
	246	790	1897	2576	3040	3530	3946	4198	4628	5110
25.0		5986	6179	6330	6214	5758	4761	3600	2711	2030
	1462	1309	1462	2030	2711	3600	4761	5758	6214	6330
	6179	5986	5660	5212	4797	4251	3313	2027	954	592
	592	954	2027	3313	4251	4797	5212	5660	5986	6179
35.0		6398	6322	6145	5806	5388	4554	3619	3103	2556
	2036	1969	2036	2556	3103	3619	4554	5388	5806	6145
	6322	6398	6245	5848	5142	4100	2977	2228	1591	1233
	1233	1591	2228	2977	4100	5142	5848	6245	6398	6322
45.0		5870	5881	5854	5505	4805	4116	3811	3579	3121
	2787	2755	2787	3121	3579	3811	4116	4805	5505	5854
	5881	5870	5634	5179	4469	3724	3128	2652	2146	1702
	1702	2146	2652	3128	3724	4469	5179	5634	5870	5881

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V1HOL4SAE1 TABLE NO. 4

HORZ. ANGLES (V 34 13)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
55.0		4724	4672	4531	4343	4326	4316	4163	3906	3582
	3344	3326	3356	3582	3906	4163	4316	4326	4343	4531
	4672	4724	4572	4277	3899	3631	3344	3012	2565	2229
	2229	2565	3012	3394	3631	3889	4277	4572	4724	4672
65.0		4423	4444	4439	4430	4324	4305	4299	4155	3909
	3724	3723	3726	3909	4155	4299	4305	4324	4430	4439
	4444	4423	4318	4182	3990	3782	3600	3290	3049	2910
	2910	3049	3290	3600	3782	3990	4182	4318	4423	4446
75.0		4265	4364	4321	4299	4263	4210	4125	4020	3903
	3842	3860	3842	3903	4020	4125	4210	4263	4299	4321
	4364	4265	4109	4044	3964	3872	3737	3587	3471	3381
	3381	3471	3587	3737	3872	3964	4044	4109	4265	4364
85.0		3939	3886	3877	3879	3875	3867	3856	3850	3850
	3849	3954	3849	3850	3950	3856	3857	3875	3879	3877
	3886	3989	3853	3866	3839	3804	3751	3756	3729	3733
	3733	3729	3756	3781	3814	3839	3866	3883	3899	3886
90.0		3775	3775	3775	3775	3775	3775	3775	3775	3775
	3775	3775	3775	3775	3775	3775	3775	3775	3775	3775
	3775	3775	3775	3775	3775	3775	3775	3775	3775	3775
	3775	3775	3775	3775	3775	3775	3775	3775	3775	3775

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V160L4MAE2 TABLE NO. 5

HORZ. ANGLES (V 39 13)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
0.0		1903	2152	2444	2652	2922	2982	2528	1490	445
	224	200	224	445	1490	2528	2982	2922	2652	2444
	2152	1903	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1903	2152
5.0		2612	3109	3490	3800	4022	3830	2751	1360	654
	422	391	422	654	1360	2751	3830	4022	3800	3490
	3109	2612	2184	1841	0	0	0	0	0	0
	0	0	0	0	0	0	1841	2184	2612	3109
10.0		3856	4300	4687	5094	4940	4049	2529	1541	965
	666	664	666	965	1541	2529	4049	4940	5094	4687
	4300	3856	3374	2853	2340	1811	1280	771	275	52
	52	275	771	1280	1811	2340	2853	3374	3856	4300
15.0		5178	5457	5668	5528	5059	3876	2590	1829	1269
	902	950	902	1269	1829	2590	3876	5059	5528	5668
	5457	5178	4596	4157	3647	2975	2309	1505	604	96
	96	604	1505	2309	2975	3647	4157	4596	5178	5457
20.0		5967	6203	6098	5625	4602	3645	2731	2100	1574
	1104	1023	1104	1574	2100	2731	3645	4602	5625	6098
	6203	5967	5636	5273	4650	3799	2749	1583	566	278
	278	566	1583	2749	3799	4650	5273	5636	5967	6203
25.0		5978	5915	5660	5116	4395	3690	2858	2313	1824
	1334	1246	1334	1824	2313	2858	3690	4395	5116	5660
	5915	5978	5631	5364	4642	3606	2410	1401	844	598
	598	844	1401	2410	3606	4642	5364	5631	5978	5915
35.0		5024	5043	4993	4736	4197	3465	3078	2712	2220
	1847	1800	1847	2220	2712	3078	3465	4197	4736	4993
	5043	5024	4850	4466	3873	3126	2420	1901	1433	1101
	1101	1433	1901	2420	3126	3873	4466	4850	5024	5043
45.0		4601	4553	4417	4050	3730	3560	3346	3032	2665
	2472	2441	2472	2665	3032	3346	3560	3730	4050	4417
	4553	4601	4372	3940	3453	3004	2651	2306	1888	1515
	1515	1888	2306	2651	3004	3453	3940	4372	4601	4553

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V18UL4MAE2 TABLE NO. 5

HORZ. ANGLES (V 39 13)										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
VERT.										
55.0		3808	3809	3826	3842	3563	3697	3537	3310	3097
	2973	3000	2973	3097	3310	3537	3697	3553	3842	3826
	3809	3808	3725	3608	3421	3167	2908	2570	2233	2011
	2011	2233	2570	2908	3167	3421	3608	3725	3808	3809
65.0		3824	3835	3796	3766	3687	3683	3594	3586	3441
	3334	3364	3334	3441	3588	3594	3583	3587	3766	3796
	3835	3824	3715	3562	3383	3202	3034	2802	2652	2579
	2579	2652	2802	3034	3202	3383	3562	3715	3824	3835
75.0		3652	3742	3728	3714	3694	3647	3582	3525	3487
	3466	3500	3466	3487	3525	3582	3647	3594	3714	3728
	3742	3652	3529	3478	3412	3316	3209	3100	3057	3021
	3021	3057	3100	3209	3316	3412	3478	3529	3652	3742
85.0		3429	3439	3441	3453	3459	3458	3454	3459	3467
	3479	3479	3479	3467	3459	3454	3458	3458	3453	3441
	3439	3429	3421	3409	3390	3367	3362	3358	3355	3354
	3354	3355	3358	3362	3367	3390	3409	3421	3429	3439
90.0		3406	3406	3406	3406	3406	3406	3406	3406	3406
	3406	3406	3406	3406	3406	3406	3406	3406	3406	3406
	3406	3406	3406	3406	3406	3406	3406	3406	3406	3406
	3406	3406	3406	3406	3406	3406	3406	3406	3406	3406

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H15CW55LA1 TABLE NO. 6

HORZ. ANGLES (H 14 12)

VERT.	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0
-55.0	0	0	0	0	20	30	30	30	30	20	0	0	0	0
-45.0	0	0	49	1300	3360	3620	3770	3770	3620	3360	1300	49	0	0
-35.0	0	50	1320	3890	4530	4480	4420	4420	4480	4530	3890	1320	50	0
-25.0	0	240	3700	5530	6005	6000	5800	5800	6000	6005	5530	3700	240	0
-15.0	20	2280	6040	8920	10160	1030	10460	10460	1030	10160	8920	6040	2280	20
-5.0	60	5030	12570	20720	25910	27880	28980	28980	27880	25910	20720	12570	5030	60
5.0	40	4910	11980	20180	25150	27220	28460	28460	27220	25150	20180	11980	4910	40
15.0	10	1630	5800	8620	9930	10100	10150	10150	10100	9930	8620	5800	1630	10
25.0	0	180	3600	5480	6080	5620	5800	5800	5620	6080	5480	3600	180	0
35.0	0	20	974	3270	4420	4510	4560	4560	4510	4420	3270	974	20	0
45.0	0	0	200	1340	2760	3550	3740	3740	3550	2760	1340	200	0	0
55.0	0	0	0	0	20	30	40	40	30	20	0	0	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H15C065H01 TABLE NO. 7

HORZ. ANGLES (H 16 16)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
-60.0	50	93	135	113	20	44	163	158	158	163	44	20	118	135	93	50
-52.0	80	190	205	175	145	218	327	317	317	327	218	145	175	205	190	80
-44.0	90	280	620	470	867	958	1350	674	674	1350	958	867	470	620	280	90
-36.0	110	470	1370	2350	3470	3740	4490	4440	4440	4490	3740	3470	2350	1370	470	110
-28.0	130	560	2270	4350	5780	6530	6700	6620	6620	6700	6530	5780	4350	2270	560	130
-20.0	160	650	3160	6640	9060	10190	10830	10620	10620	10830	10190	9060	6640	3160	650	160
-12.0	190	700	4260	9470	13400	15860	17320	17510	17510	17320	15860	13400	9470	4260	700	190
-4.0	220	750	4880	11760	17930		24880	25480	25480	24880	22170	17930	11760	4880	750	
4.0	210	720	4810	11640	17640	21690	24310	24960	24960	24310	21690	17640	11640	4810	720	210
12.0	180	700	4055	9000	12870	15070	16420	16640	16640	16420	15070	12870	9000	4055	700	180
20.0	150	650	3020	6170	8430	9500	9930	9870	9870	9930	9500	8430	6170	3020	650	150
28.0	120	560	2060	4000	5300	6010	6170	6100	6100	6170	6010	5300	4000	2060	560	120
36.0	100	470	1170	2190	3230	3220	3680	4160	4160	3680	3220	3230	2190	1170	470	100
44.0	85	280	410	470	819	784	1140	674	674	1140	784	819	470	410	280	85

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: M15C065MU1 TABLE NO. 7

HORZ. ANGLES (H 16 16)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
52.0	75	190	205	175	145	218	327	317	317	327	218	145	175	205	190	75
60.0	30	93	135	118	29	44	163	158	158	163	44	20	118	135	93	30

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V35WL4MN01 TABLE NO. 8

HORZ. ANGLES (V 38 9)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
5.0		56	97	217	286	303	300	290	313	365
	404	404	365	313	290	300	303	286	217	97
	56	83	71	34	16	4	0	0	0	0
	0	0	4	16	34	71	83	56	97	
15.0		123	185	343	443	459	413	435	532	664
	715	715	664	532	435	413	459	443	343	185
	123	119	72	35	18	9	2	0	0	0
	0	2	9	18	35	72	119	123	185	
25.0		150	238	375	501	565	619	707	811	899
	923	923	899	811	707	619	565	501	375	238
	150	147	103	51	29	21	16	14	13	13
	14	16	21	29	51	103	147	150	238	
35.0		184	282	397	504	615	765	859	933	994
	1014	1014	994	933	859	765	615	504	397	282
	184	168	133	94	53	37	28	27	25	25
	27	28	37	53	94	133	168	184	282	
45.0		222	313	425	535	644	763	874	961	1010
	1032	1032	1010	961	874	763	644	535	425	313
	222	203	182	158	118	79	52	44	44	44
	44	52	79	118	158	182	203	222	313	
55.0		301	374	483	598	694	785	870	941	990
	1020	1020	990	941	870	785	694	598	483	374
	301	286	281	265	236	208	174	144	128	128
	144	174	208	236	265	281	286	301	374	
65.0		379	446	527	635	723	800	859	896	928
	948	948	928	896	859	800	723	635	527	446
	379	351	351	360	354	352	344	342	344	344
	342	344	352	354	360	351	351	379	446	
75.0		437	478	521	573	625	680	724	747	774
	788	788	774	747	724	680	625	573	521	478
	437	400	380	384	388	390	391	395	400	400
	395	391	390	388	384	380	400	437	478	

```
CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V35WL4MN01 TABLE NO.   6

HORZ. ANGLES  (V    39      9)
               -5.0    5.0   15.0   25.0   35.0   45.0   55.0   65.0   75.0
        85.0   95.0  105.0  115.0  125.0  135.0  145.0  155.0  165.0  175.0
       185.0  195.0  205.0  215.0  225.0  235.0  245.0  255.0  265.0  275.0
       285.0  295.0  305.0  315.0  325.0  335.0  345.0  355.0  365.0
VERT.

 85.0           476    490    504    523    537    547    553    557    562
         564    564    562    557    553    547    537    523    504    490
         476    465    450    436    425    417    413    411    410    410
         411    413    417    425    436    450    465    476    490
```

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V55WL45N01 TABLE NO. 9

HORZ. ANGLES (V 36 9)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
5.0		92	166	356	436	457	460	463	493	543
	584	584	543	493	463	460	457	436	356	166
	92	114	101	44	22	11	4	3	3	3
	3	4	11	22	44	101	114	92	166	
15.0		184	281	540	673	653	591	653	801	948
	1030	1030	948	801	653	591	653	673	540	281
	184	167	104	47	27	15	8	4	5	5
	4	8	15	27	47	104	167	184	281	
25.0		229	339	559	777	879	935	1030	1195	1308
	1361	1361	1308	1195	1030	935	879	777	559	339
	229	225	157	70	41	31	27	22	21	21
	22	27	31	41	70	157	225	229	339	
35.0		275	376	545	733	926	1175	1341	1471	1539
	1566	1566	1539	1471	1341	1175	926	733	545	376
	275	272	223	141	72	54	44	41	38	38
	41	44	54	72	141	223	272	275	376	
45.0		325	412	558	746	956	1145	1361	1505	1578
	1602	1602	1578	1505	1361	1145	956	746	558	412
	325	321	295	255	173	110	80	72	71	71
	72	80	110	173	255	295	321	325	412	
55.0		435	502	611	754	936	1113	1269	1405	1479
	1506	1506	1479	1405	1269	1113	936	754	611	502
	435	434	427	397	354	292	226	181	152	152
	181	226	292	354	397	427	434	435	502	
65.0		537	598	677	789	901	1021	1123	1199	1253
	1273	1273	1253	1199	1123	1021	901	789	677	598
	537	531	536	544	538	528	523	515	511	511
	515	523	528	538	544	536	531	537	596	
75.0		592	627	670	706	762	812	870	903	919
	930	930	919	903	870	812	762	706	670	627
	592	564	569	580	586	598	591	596	587	587
	596	591	598	586	580	569	564	592	627	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V55WL4SN01 TABLE NO. 9

HORZ. ANGLES (V 38 9)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
85.0		628	634	647	652	679	690	697	700	699
	699	699	699	700	697	690	679	662	647	634
	624	617	602	590	580	574	572	576	577	577
	576	572	574	580	590	602	617	624	634	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H10CS75CH1 TABLE NO. 10

HORZ. ANGLES (H 15 14)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
-76.0	246	404	727	1108	1573	2178	2817	3221	3221	2817	2178	1573	1108	727	404	246
-68.0	468	937	1938	12422	15168	16687	17592	17963	17963	17592	16687	15168	12422	1938	937	468
-60.0	646	1615	10419	16655	18835	20112	21145	21872	21872	21145	20112	18835	16655	10419	1615	646
-52.0	1066	5428	14438	19482	21840	24457	26686	26592	26592	26686	24457	21840	19482	14438	5428	1066
-44.0	1712	9272	16380	20418	24166	29497	36605	44552	44552	36605	29497	24166	20418	16380	9272	1712
-36.0	2649	10532	15960	20289	26815	40191	64098	90268	90268	64098	40191	26815	20289	15960	10532	2649
-28.0	3036	9951	14797	19902	33277	55634	84065	105646	105646	84065	55634	33277	19902	14797	9951	3036
-20.0	2843	8206	12665	18609	32695	50529	72757	89751	89751	72757	50529	32695	18609	12665	8206	2843
-12.0	2326	6303	10985	16800	28302	39157	53954	64034	64034	53954	39157	28302	16800	10985	6303	2326
-4.0	1518	4523	9498	14312	18835	24328	31823	37542	37542	31823	24328	18835	14312	9498	4523	1518
4.0	888	1842	2988	4491	5185	6106	9385	12891	12891	9385	6106	5185	4491	2988	1842	888
12.0	607	1047	1809	2921	3418	4129	5964	7657	7657	5964	4129	3418	2921	1809	1047	607
20.0	498	795	1370	2171	2468	3173	5079	6668	6668	5079	3173	2468	2171	1370	795	498
28.0	417	620	934	1370	1593	2094	3512	4838	4838	3512	2094	1593	1370	934	620	417

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V150S4LLA1 TABLE NO. 11

HORZ. ANGLES (V 21 21)

VERT.	0.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
-10.0	195	230	234	278	449	610	712	979	1183
-5.0	212	292	303	358	581	776	993	1340	1862
0.0	252	413	438	529	895	1165	1566	2147	2724
5.0	340	661	661	803	1621	2019	2538	3195	3940
10.0	635	1106	1026	1205	2289	3640	4798	5849	5893
15.0	1099	1581	1461	1683	3031	4152	5039	5221	5196
20.0	1475	1625	1581	1384	2048	2885	3129	3370	3392
25.0	1325	1672	1431	1384	1906	2574	2691	3089	3297
30.0	1585	2151	1446	1475	2056	2611	2600	2804	3151
35.0	2019	2771	2037	1650	2267	2724	2695	2702	2804
40.0	2695	3553	2749	1972	2344	2859	2822	2736	2757

VERT.	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0	180.0
-10.0	1150	1099	1150	1183	979	712	610	449	278	234	230	195
-5.0	2005	1944	2005	1862	1340	993	776	581	358	303	292	212
0.0	3027	3078	3027	2724	2147	1566	1165	895	529	438	413	252
5.0	4049	3987	4049	3940	3195	2538	2019	1621	803	661	661	340
10.0	5853	5700	5853	5893	5849	4798	3640	2289	1205	1026	1106	635
15.0	4845	4791	4845	5196	5221	5039	4152	3031	1683	1461	1581	1099
20.0	3443	3425	3443	3392	3370	3129	2885	2048	1384	1581	1625	1475
25.0	3418	3377	3418	3297	3089	2691	2574	1906	1384	1431	1672	1325
30.0	3429	3469	3429	3151	2804	2600	2611	2056	1475	1446	2151	1585
35.0	2844	2848	2844	2804	2702	2695	2724	2267	1650	2037	2771	2019
40.0	2760	2768	2760	2757	2736	2822	2859	2344	1972	2749	3553	2695

[illegible]

[illegible] TABLE - CONT [illegible] TABLE NO. 11

HORZ. ANGLES (V 21 21)

VERT.	0.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0	180.0
45.	3635	4035	3414	2552	2297	2553	2332	3052	3056	2901	2934	2990	3058	3152	2432	2553	2297	2552	3414	4036	3635
50.0	3432	4232	3385	3145	2511	2472	2565	2317	3095	3023	3027	3023	3095	2417	2565	2472	2511	3145	3385	4232	3432
55.0	3301	4009	4298	3751	3217	25[illegible]	2549	2571	2561	2576	2735	2675	2531	2571	2549	2[illegible]	3217	3751	4298	400[illegible]	3301
60.0	3122	3611	4476	3937	3455	31[illegible]	2533	2555	2695	2739	2724	2738	2545	2655	2533	31[illegible]	3455	3937	4476	3611	3122
65.0	2914	3159	4115	3865	3345	3135	2[illegible]	2506	2747	2773	2786	2773	2747	2808	2491	3135	3345	3865	4115	3164	2914
70.0	2745	2955	3331	3319	3144	3015	3057	3150	3205	3196	3195	3195	3205	3150	3057	3010	3144	3319	3331	2958	2745
75.	2826	2925	3065	3154	3319	3443	3534	3441	3455	3407	3363	3407	3455	3441	3534	3443	3319	3144	3[illegible]	2925	2826
80.0	2954	3027	3155	3261	3348	3421	3494	3564	3604	3604	3626	3604	3564	3564	3494	3421	3348	3261	3155	3027	2954
85.0	2947	2972	2969	3034	3074	3057	3089	3012	3023	3054	3056	3056	3023	3012	3084	3057	3075	3034	2959	2972	2947
90.0	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337	2337

[illegible] TABLE NO. 12

HORZ. ANGLES

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
-68.0	0	0	69	103	172	241	275	275	344	344	275	275	241	172	103	69	0	0
-60.0	69	69	103	172	241	275	344	344	413	413	344	344	275	241	172	103	69	69
-52.0	69	103	172	241	275	344	413	413	447	447	413	413	344	275	241	172	103	69
-44.0	138	550	1410	2477	3440	3784	4369	4094	4575	4575	4094	4369	3784	3440	2477	1410	550	138
-36.0	241	963	2236	3440	4541	4850	5536	5263	5814	5814	5263	5536	4850	4541	3440	2236	963	241
-28.0	413	1376	2993	4782	6020	6536	7396	7086	7878	7878	7086	7396	6536	6020	4782	2993	1376	413
-20.0	516	1720	4059	6467	8255	9288	10459	10354	11180	11180	10354	10459	9288	8255	6467	4059	1720	516
-12.0	432	1995	6022	8462	11490	13554	15445	15377	15478	15478	15377	15445	13554	11490	8462	6022	1995	432
-4.0	585	2546	[illegible]	11627	15462	18494	21544	21741	23323	23323	21741	21544	18494	15462	11627	[illegible]	2546	585
4.0	516	2408	6605	11352	15755	18886	21810	21913	23667	23667	21913	21810	18886	15755	11352	6605	2408	516
12.0	516	2157	5470	9944	11937	13966	15962	15962	16994	16994	15962	15962	13966	11937	9944	5470	2157	516
20.0	447	1720	4094	6605	8566	9599	10870	10733	11455	11455	10733	10870	9599	8566	6605	4094	1720	447
28.0	378	1410	3096	4919	6192	6777	7774	7465	8153	8153	7465	7774	6777	6192	4919	3096	1410	378
36.0	241	1032	2167	3573	4644	4983	5745	5471	6054	6054	5471	5745	4983	4644	3573	2167	1032	241

[illegible]										
44.		172	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
52.		[illegible]	[illegible]	172	241	[illegible]	344	413	413	516
	516	413	413	344	275	241	172	[illegible]	[illegible]	
60.		[illegible]	[illegible]	[illegible]	172	241	275	344	334	447
	447	334	344	275	241	172	[illegible]	[illegible]	[illegible]	
68.		[illegible]	[illegible]	[illegible]	103	172	241	275	275	413
	413	275	275	241	172	103	[illegible]	[illegible]	[illegible]	

B36

[illegible]

[illegible] No. 13

HORZ. ANGLES (H 13 11)

VERT.	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0
-50.0	0	0	0	780	780	790	790	790	780	780	0	0	0
-40.0	0	960	960	1280	1280	1330	1360	1330	1280	1280	960	600	0
-30.0	0	1200	1200	1300	1360	1420	1480	1420	1360	1300	1200	530	0
-20.0	700	1350	1350	1600	1800	2050	2300	2050	1800	1600	1350	1000	0
-10.0	800	3600	3600	4500	5600	6700	7900	6700	5600	4500	3600	2100	700
0.0	700	4700	4700	7200	8700	9500	10187	9500	8700	7200	4700	2200	800
10.0	0	3600	3600	4500	5600	6700	7900	6700	5600	4500	3600	2100	700
20.0	0	1350	1350	1600	1800	2050	2300	2050	1800	1600	1350	1000	0
30.0	0	1200	1200	1300	1360	1420	1480	1420	1360	1300	1200	540	0
40.0	0	950	960	1280	1280	1330	1350	1330	1280	1280	950	600	0
50.0	1.1449	0	0	780	780	790	790	790	780	780	0	0	0

TABLE NO. 14

HORZ. ANGLES (H 15 13)

VERT.	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0
-60.0	0	0	0	0	0	1500	1500	2000	1400	1500	0	0	0	0	0
-50.0	0	0	1600	2100	2600	3100	3300	3400	3300	3100	2600	2100	1600	0	0
-40.0	0	1500	2100	2800	3300	3400	3500	3600	3500	3400	3300	2800	2100	1500	0
-30.0	0	1600	2300	3000	3400	3600	3600	3950	3800	3600	3400	3000	2300	1600	0
-20.0	1500	1800	2800	3600	4300	4900	5600	6200	5600	4900	4300	3600	2800	1800	0
-10.0	2500	3200	5400	13200	11000	14000	15200	15500	15200	14000	11000	13200	5400	3200	1500
0.0	1500	6800	13200	18300	22200	24500	26500	26050	26500	24500	22200	18300	13200	6800	2500
10.0	0	3200	5400	13200	11000	14000	15200	15500	15200	14000	11000	13200	5400	3200	1500
20.0	0	1800	2800	3600	4300	4900	5600	6200	5600	4900	4300	3600	2800	1800	0
30.0	0	1600	2300	3000	3400	3600	3600	3950	3800	3600	3400	3000	2300	1600	0
40.0	0	1500	2100	2800	3300	3400	3500	3600	3500	3400	3300	2800	2100	1500	0
50.0	0	0	1500	2100	2600	3100	3300	3400	3300	3100	2600	2100	1600	0	0
60.0	22302	0	0	0	0	1500	1400	2000	1400	1500	0	0	0	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H10C576HU1 TABLE NO. 15

HORZ. ANGLES (H 15 16)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
-75.0	130	155	287	380	462	543	660	592	592	660	543	462	380	287	155	130
-65.0	260	368	747	1310	2010	2320	2860	2730	2730	2860	2320	2010	1310	747	368	260
-55.0	400	698	1610	4910	6590	7610	7960	8030	8030	7960	7610	6590	4910	1610	698	400
-45.0	525	1400	3851	11300	14500	16700	16870	16800	16800	16870	16700	14500	11300	3851	1400	525
-35.0	600	2250	8850	17200	22500	27100	29150	29000	29000	29150	27100	22500	17200	8850	2250	600
-25.0	650	3640	13200	20600	28400	37000	41700	41200	41200	41700	37000	28400	20600	13200	3640	650
-15.0	700	5270	15800	22200	31600	43400	50000	48800	48800	50000	43400	31600	22200	15800	5250	700
-5.0	750	6740	16700	22500	32500	46000	52700	50500	50500	52700	46000	32500	22500	16700	6740	750
5.0	750	7910	16100	21500	30562	42900	49300	46500	46500	49300	42900	30560	21500	16100	7910	755
15.0	700	8140	14500	19200	26300	35400	39900	37400	37400	39900	35400	26300	19200	14500	8140	700
25.0	650	7130	12400	16100	21100	26200	28200	26600	26600	28200	26200	21100	16100	12400	7130	650
35.0	600	5580	9890	12800	15800	18200	19000	18600	18600	19000	18200	15800	12800	9890	5580	600
45.0	525	3260	7070	9210	11100	12600	13300	13400	13400	13300	12600	11100	9210	7070	3260	525
55.0	400	550	3910	5230	6710	8010	8670	9010	9010	8670	8010	6710	5220	3910	550	400

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 15

HORZ. ANGLES (H 1- 15)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	65.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
65.0	300	620	1490	2330	3210	3950	4530	4700	4700	4630	3950	3210	2320	1490	620	300
75.0	260	388	670	987	1370	1670	1840	1840	1840	1840	1670	1370	981	690	388	260

B40

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H10CS75CH2 TABLE NO. 15

HORZ. ANGLES (H 15 14)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
-65.0	0	0	0	0	0	0	0	99	99	0	0	0	0	0	0	0
-55.0	0	0	0	0	201	1304	2653	3289	3289	2653	1304	201	0	0	0	0
-45.0	0	0	0	1355	3735	5362	6701	7697	7697	6701	5362	3735	1355	0	0	0
-35.0	0	0	3046	5899	7671	9928	11224	12336	12336	11224	9928	7671	5899	3046	0	0
-25.0	0	3876	8391	10514	13454	15187	16054	16283	16283	16054	15187	13454	10514	8391	3876	0
-15.0	3553	13101	15690	18925	21727	22029	21156	21809	21809	21156	22029	21727	18925	15690	13101	3553
-5.0	15921	26744	30690	31916	33213	33007	31973	33849	33849	31973	33007	33213	31916	30690	26744	15921
5.0	18554	27519	30805	32009	31968	34275	35680	35855	35855	35680	34275	31968	32009	30805	27519	18554
15.0	4868	14109	16049	18458	20643	23297	24660	24572	24572	24660	23297	20643	18458	16049	14109	4868
25.0	0	3721	8161	9907	12410	15725	18639	17336	17336	18639	15725	12410	9907	8161	3721	0
35.0	0	0	2126	5280	7269	9928	12007	13750	13750	12007	9928	7269	5280	2126	0	0
45.0	0	0	0	888	3574	5399	7109	8388	8388	7109	5399	3574	888	0	0	0
55.0	0	0	0	0	121	1263	2553	3289	3289	2653	1263	121	0	0	0	0
65.0	0	0	0	0	0	0	0	99	99	0	0	0	0	0	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H400S54CH1 TABLE NO. 17

HORZ. ANGLES (H 14 13)

VERT.	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0
-27.5	0	0	0	0	0	884	4408	4408	884	0	0	0	0	0
-22.5	0	0	0	0	0	4354	8553	8553	4354	0	0	0	0	0
-17.5	0	0	0	0	870	8503	12171	12171	8503	870	0	0	0	0
-12.5	156	0	0	0	5217	11972	18355	18355	11972	5217	0	0	0	0
-7.5	17031	2299	4259	4640	12173	18775	33026	33026	18775	12173	4640	4259	2299	156
-2.5	11406	22069	25185	31920	40072	52721	71513	71513	52721	40072	31920	25185	22069	17031
2.5	0	19540	22778	27280	40217	56802	69868	69868	56802	40217	27280	22778	19540	11406
7.5	0	1609	3333	4320	13260	20816	40066	40066	20816	13260	4320	3333	1609	0
12.5	0	0	0	0	6594	13197	33553	33553	13197	6594	0	0	0	0
17.5	0	0	0	0	1884	12789	13881	13881	12789	1884	0	0	0	0
22.5	0	0	0	0	0	5374	9473	9473	5374	0	0	0	0	0
27.5	0	0	0	0	0	1224	6710	6710	1224	0	0	0	0	0
32.5	0	0	0	0	0	0	1250	1250	0	0	0	0	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V10C57GCH1 TABLE NO. 18

HORZ. ANGLES (V 16 14)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
-76.0	224	375	675	1029	1461	2022	2516	2991	2991	2516	2022	1461	1029	675	375	224
-68.0	435	870	1800	11535	14085	15495	16335	16680	16680	16335	15495	14085	11535	1800	870	435
-60.0	600	1500	9675	15465	17490	18675	19535	20310	20310	19635	18675	17490	15465	9675	1500	600
-52.0	990	5040	13500	18090	20280	22710	24780	26550	26550	24780	22710	20280	18090	13500	5040	990
-44.0	1590	8610	15210	18960	22440	27390	33990	41370	41370	33990	27390	22440	18960	15210	8610	1590
-36.0	2460	9780	14820	18840	24900	37320	59520	83820	83820	59520	37320	24900	18840	14820	9780	2460
-28.0	2820	9240	13740	18480	30900	51660	78060	98100	98100	78060	51660	30900	18480	13740	9240	2820
-20.0	2640	7620	11760	17280	30360	46920	67560	83340	83340	67560	46920	30360	17280	11760	7620	2640
-12.0	2160	5760	10200	15600	26230	36360	50100	59460	59460	50100	36360	26230	15600	10200	5760	2160
-4.0	1410	4200	8820	13290	17490	22590	29550	34860	34860	29550	22590	17490	13290	8820	4200	1410
4.0	825	1710	2775	4170	4815	5760	8715	11970	11970	8715	5760	4815	4170	2775	1710	825
12.0	564	972	1680	2712	3174	3834	5538	7110	7110	5538	3834	3174	2712	1680	972	564
20.0	462	734	1272	2016	2292	2945	4716	6192	6192	4716	2945	2292	2016	1272	734	462
28.0	387	576	867	1272	1479	1944	3261	4452	4452	3261	1944	1479	1272	867	576	387

...NDLEPOWER TABLE PRINTOUT

...NDLEPOWER TABLE - LUM... TABLE NO. 19

HORZ. ANGLES (H 1 19)

VERT.	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
-85.0	3880	6790	4898	5324	4320	5905	8474	9097	10426	10426	9097	8474	5905	4320	5324	4898	6790	3880
-75.0	11593	20793	13547	13755	14884	15492	14724	14652	15674	15674	14652	14724	15492	14884	13755	13547	20793	11593
-65.0	19159	33513	21814	21090	20839	20938	18011	14652	14694	14694	14652	18011	20938	20839	21090	21814	33513	19159
-55.0	26458	45020	31563	26118	32886	42974	40300	42340	47340	47340	42340	40300	42974	32886	26118	31563	45020	26458
-45.0	33340	57840	42588	33620	47551	47077	48062	61662	64966	64966	61662	48062	47077	47551	33620	42588	57840	33340
-35.0	39619	73927	58088	48078	47712	56597	57500	50146	51281	51281	50146	57500	56597	47712	48078	58088	73927	39619
-25.0	45081	83294	76774	66856	54462	69726	64430	59870	56126	56126	59870	64430	69726	54462	66856	76774	83294	45081
-15.0	49487	91871	95866	95538	107723	100183	127212	117494	121351	121351	117494	127212	100183	107723	95538	95866	91871	49487
-5.0	52592	100600	114624	124829	160953	157333	182775	203259	199085	199085	203259	182775	157333	160953	124829	114624	100600	52592
5.0	52592	100600	114624	124829	160953	157333	182775	203259	199085	199085	203259	182775	157333	160953	124829	114624	100600	52592
15.0	49487	91871	95866	95538	107723	100183	127212	117494	121351	121351	117494	127212	100183	107723	95538	95866	91871	49487
25.0	45081	83294	76774	66856	54462	69726	64430	59870	56126	56126	59870	64430	69726	54462	66856	76774	83294	45081
35.0	39619	73927	58088	48078	47712	56597	57500	50146	51281	51281	50146	57500	56597	47712	48078	58088	73927	39619
45.0	33340	57840	42588	33620	47551	47077	48062	61662	64966	64966	61662	48062	47077	47551	33620	42588	57840	33340

B44

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 19

HORZ. ANGLES (H [illegible])

VERT.	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
55.0	26458	45020	31563	26114	32835	42974	40300	42340	47340	47340	42340	40300	42974	32835	26114	31563	45020	26458
65.0	19159	33513	21414	21099	20894	20938	16011	14652	14694	14694	14652	16011	20938	20894	21099	21414	33513	19159
75.0	11593	20793	13547	13755	14884	15492	14724	14652	15674	15674	14652	14724	15492	14884	13755	13547	20793	11593
85.0	3880	6790	4898	5326	4320	5905	8474	9097	10426	10426	9097	8474	5905	4320	5326	4898	6790	3880

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE COVER 4300-68-1 TABLE NO. 20

HORZ. ANGLES (H 1- 14)

VERT.	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0
-52.0	0	0	72	99	93	89	117	117	89	93	99	72	0	0
-44.0	94	31	359	527	619	714	728	728	714	619	527	359	31	94
-36.0	94	324	611	757	836	951	932	932	951	836	757	611	324	94
-28.0	139	485	791	1087	1237	1447	1515	1515	1447	1237	1087	791	485	139
-20.0	243	607	1114	1482	1732	2051	2155	2155	2051	1732	1482	1114	607	243
-12.0	283	758	1401	1976	2444	2914	3175	3175	2914	2444	1976	1401	758	283
-4.0	377	890	1833	2634	3310	4073	4340	4340	4073	3310	2634	1833	890	377
4.0	339	849	1833	2657	3402	4073	4283	4283	4073	3402	2657	1833	849	339
12.0	283	755	1473	2040	2536	3003	3175	3175	3003	2536	2040	1473	755	283
20.0	283	688	1078	1415	1910	2200	2415	2415	2200	1910	1415	1078	688	283
28.0	236	485	862	1120	1330	1516	1602	1602	1516	1330	1120	862	485	236
36.0	142	404	611	856	928	1041	1078	1078	1041	928	856	611	404	142
44.0	94	162	503	527	619	714	728	728	714	619	527	503	162	94
52.0	0	0	72	99	93	89	117	117	89	93	99	72	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] TABLE NO. 21

HORZ. ANGLES [illegible]

VERT.	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
-85.0	4	10	17	22	25	30	34	33	33
-75.0	12	24	44	74	115	171	221	230	220
-65.0	20	50	123	225	321	437	495	521	529
-55.0	26	92	223	411	2443	2654	2449	2325	2240
-45.0	31	152	366	2704	4525	4340	4141	3910	3900
-35.0	35	221	596	5060	5144	5035	4983	4904	4820
-25.0	39	291	1611	6361	6094	6152	5792	5749	5521
-15.0	41	359	5629	13560	13517	12759	10630	11204	10881
-5.0	43	415	9264	25531	29144	24675	16292	17462	16234
5.0	43	427	11647	30416	34111	27190	17433	18969	17087
15.0	42	390	9397	28419	32678	27287	15843	16997	15656
25.0	40	322	4341	19213	17000	11509	8127	7871	7061
35.0	37	234	2057	7565	5995	5325	5011	4968	4656
45.0	34	152	440	4095	4604	4230	3951	3936	3511

VERT.	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
-85.0	33	33	34	30	25	22	17	10	4
-75.0	220	230	221	171	115	74	44	24	12
-65.0	529	521	495	437	321	225	123	50	20
-55.0	2240	2325	2449	2654	2443	411	223	92	26
-45.0	3900	3910	4141	4340	4525	2704	366	152	31
-35.0	4820	4904	4983	5035	5144	5060	596	221	35
-25.0	5521	5749	5792	6152	6094	6361	1611	291	39
-15.0	10881	11204	10630	12759	13517	13560	5629	359	41
-5.0	16234	17462	16292	24675	29144	25531	9264	415	43
5.0	17087	18969	17433	27190	34111	30416	11647	427	43
15.0	15656	16997	15843	27287	32678	28419	9397	390	42
25.0	7061	7871	8127	11509	17000	19213	4341	322	40
35.0	4656	4968	5011	5325	5995	7565	2057	234	37
45.0	3511	3936	3951	4230	4604	4095	440	152	34

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 21

HORZ. ANGLES (H 1 - 18)

VERT.	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
55.0	29	91	213	410	2180	2023	1823	1719	1533	1533	1719	1823	2023	2180	410	213	91	29
65.0	23	52	138	175	233	297	327	348	363	363	348	327	297	233	175	138	52	23
75.0	14	34	51	73	100	138	170	183	193	193	183	170	138	100	73	51	34	14
85.0	5	14	25	29	37	42	51	55	53	53	55	51	42	37	29	25	14	5

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible]-81 TABLE NO. 22

HORZ. ANGLES (H 12 12)

VERT.	24.0	36.0	48.0	60.0	72.0	84.0	96.0	108.0	120.0	132.0	144.0	156.0
-55.0	0	135	144	55	0	0	0	0	55	144	135	0
-45.0	39	2189	2095	1453	1670	1629	1629	1670	1453	2095	2189	39
-35.0	1250	2811	2843	2597	2322	2061	2061	2322	2597	2843	2811	1250
-25.0	2422	3378	3933	5064	4009	2603	2603	4009	5064	3933	3378	2422
-15.0	2500	3892	5686	7740	6831	6070	6070	6831	7740	5686	3892	2500
-5.0	2578	4216	7140	10326	13630	12700	12700	13630	10326	7140	4216	2578
5.0	2539	4108	7375	11560	13463	13019	13019	13463	11560	7375	4108	2539
15.0	2500	3892	6199	9535	9136	7939	7939	9136	9535	6199	3892	2500
25.0	2383	3568	4297	4807	4359	3019	3019	4359	4807	4297	3568	2383
35.0	430	2946	3100	2661	2455	2141	2141	2455	2661	3100	2946	430
45.0	39	2297	2344	2183	1747	1534	1534	1747	2183	2344	2297	39
55.0	0	279	791	734	217	0	0	217	734	791	279	0

CANDLEPOWER TABLE [illegible]

CANDLEPOWER TABLE - [illegible] TABLE NO. 23

HORZ. ANGLES (H 14 14)

VERT.	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0
-52.0	145	143	241	351	544	511	701	701	511	544	351	241	143	145
-44.0	195	1146	2384	3562	4036	4633	4373	4373	4633	4036	3562	2384	1146	195
-36.0	349	1649	3434	4417	5669	6343	6229	6229	6343	5669	4417	3434	1649	349
-28.0	583	2364	4826	6824	7891	9106	8828	8828	9106	7891	6824	4826	2364	583
-20.0	641	3080	6105	9731	10249	11472	11491	11491	11472	10249	9731	6105	3080	641
-12.0	875	3725	7616	11089	13107	15489	15388	15388	15489	13107	11089	7616	3725	875
-4.0	1070	4441	9186	13447	16372	18234	18358	18358	18234	16372	13447	9186	4441	1070
4.0	1070	4513	9302	13347	16190	18234	18812	18812	18234	16190	13347	9302	4513	1070
12.0	973	3858	7549	11290	13469	[illegible]	14677	14677	14430	13469	11290	7549	3858	973
20.0	875	3080	6395	9182	10639	12511	12500	12500	12511	10639	9182	6395	3080	875
28.0	778	2364	5058	7075	8118	9532	9447	9447	9532	8118	7075	5058	2364	778
36.0	583	1862	3779	5319	5941	6694	6724	6724	6694	5941	5319	3779	1862	583
44.0	344	1259	2558	3743	4354	[illegible]	4455	4455	4544	4354	3743	2558	1259	344
52.0	145	143	344	602	771	644	365	546	594	771	602	344	143	145

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible]400S/6[illegible]EL TABLE NO. 24

HORZ. ANGLES (H 12 .12)

VERT.	24.0	36.0	48.0	60.0	72.0	84.0	96.0	108.0	120.0	132.0	144.0	156.0
-55.0	0	256	252	108	0	0	0	0	108	252	266	0
-45.0	77	4315	4123	3644	3285	3203	3203	3285	3644	4123	4315	77
-35.0	2465	5540	5595	5303	4567	4051	4051	4567	5303	5595	5540	2465
-25.0	4776	6659	7749	9957	7885	5119	5119	7885	9957	7749	6659	4776
-15.0	4930	7671	11190	15296	13437	11934	11934	13437	15296	11190	7671	4930
-5.0	5084	8310	14050	21285	26808	24967	24967	26808	21285	14050	8310	5084
5.0	5007	8097	14513	22728	26480	25595	25595	26480	22728	14513	8097	5007
15.0	4930	7671	12199	18687	17971	15608	15608	17971	18687	12199	7671	4930
25.0	4699	7032	8455	9452	8476	5936	5936	8476	9452	8455	7032	4699
35.0	847	5807	6100	5231	4829	4208	4208	4829	5231	6100	5807	847
45.0	77	4528	4711	4293	3515	3015	3015	3515	4293	4711	4528	77
55.0	0	533	1556	1443	427	0	0	427	1443	1556	533	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H300PRESAGE TABLE NO. 25

HORZ. ANGLES (H 16 16)

VERT.	60.0	64.0	68.0	72.0	76.0	80.0	84.0	88.0	92.0	96.0	100.0	104.0	108.0	112.0	116.0	120.0
-15.0	0	0	400	700	800	900	1000	1000	1000	1000	900	800	700	400	0	0
-13.0	0	300	800	1300	1350	1500	2000	2000	2000	2000	1500	1350	1300	800	300	0
-11.0	200	700	1400	2150	3000	3700	4000	4000	4000	4000	3700	3000	2150	1400	700	200
-9.0	400	1000	2250	3500	4500	5200	5700	6000	6000	5700	5200	4500	3500	2250	1000	400
-7.0	750	1600	3000	4400	5500	6800	7800	8000	8000	7800	6800	5500	4400	3000	1600	750
-5.0	900	2000	3800	5000	6300	8100	8700	9000	9000	8700	8100	6300	5000	3800	2000	900
-3.0	1000	2500	4300	5600	7800	8500	9300	10000	10000	9300	8500	7800	5600	4300	2500	1000
-1.0	1000	2500	4400	6000	8000	8900	9650	10500	10500	9650	8900	8000	6000	4400	2500	1000
1.0	1000	2500	4400	6000	8000	8900	9650	10500	10500	9650	8900	8000	6000	4400	2500	1000
3.0	1000	2500	4300	5600	7800	8500	9300	10000	10000	9300	8500	7800	5600	4300	2500	1000
5.0	900	2000	3800	5000	6300	8100	8700	9000	9000	8700	8100	6300	5000	3800	2000	900
7.0	750	1600	3000	4400	5500	6800	7800	8000	8000	7800	6800	5500	4400	3000	1600	750
9.0	400	1000	2250	3500	4500	5200	5700	6000	6000	5700	5200	4500	3500	2250	1000	400
11.0	200	700	1400	2150	3000	3700	4000	4000	4000	4000	3700	3000	2150	1400	700	200

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H300HSEWAE TABLE NO. 25

HORZ. ANGLES (H 16 16)

VERT.	60.0	64.0	68.0	72.0	76.0	80.0	84.0	88.0	92.0	96.0	100.0	104.0	108.0	112.0	116.0	120.0
13.0	0	300	800	1300	1650	1800	2000	2000	2000	2000	1800	1650	1300	800	300	0
15.0	0	0	400	700	800	900	1000	1000	1000	1000	900	800	700	400	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H400S55H01 TABLE NO. 26

HORZ. ANGLES (H 18 15)

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
-60.0	0	0	0	0	58	62	174	279	383	383	279	174	62	58	0	0	0	0
-52.0	0	0	89	152	607	865	987	1061	1094	1094	1061	987	865	607	152	89	0	0
-44.0	0	0	266	759	2294	3275	3833	4298	4594	4594	4298	3833	3276	2294	759	266	0	0
-36.0	0	109	620	1747	4048	6243	7549	9042	10009	10009	9042	7549	6243	4048	1747	620	109	0
-28.0	0	436	1063	3341	6409	8775	11962	15014	15956	15956	15014	11962	8778	6409	3341	1063	436	0
-20.0	146	546	1683	4784	8163	11374	16318	21265	25215	25215	21265	16318	11374	8163	4784	1683	546	146
-12.0	146	764	2215	5771	9917	13970	19860	28466	37685	37685	28466	19860	13970	9917	5771	2215	764	146
-4.0	146	873	2480	6378	10591	15577	22647	34717	53602	53602	34717	22647	15577	10591	6378	2480	873	146
4.0	146	873	2569	6378	10389	14897	21486	31368	44468	44468	31368	21486	14897	10389	6378	2569	873	146
12.0	146	655	2480	5771	9040	12548	17130	23163	28551	28551	23163	17130	12548	9040	5771	2480	655	146
20.0	0	436	1949	4708	7488	10076	13414	16968	19581	19581	16968	13414	10076	7488	4708	1949	436	0
28.0	0	436	1506	3721	6274	8036	10162	12503	14002	14002	12503	10162	8036	6274	3721	1506	436	0
36.0	0	218	886	2582	4520	6182	7549	8875	9845	9845	8875	7549	6182	4520	2582	886	218	0
44.0	0	0	443	1443	2564	3833	5168	5637	6235	6235	5637	5168	3833	2564	1443	443	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 25

HORZ. ANGLES (H 15 1-)

VERT.									
	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0
	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
52.0	0	0	177	456	1012	1916	2149	2456	2571
	2571	2456	2149	1916	1012	456	177	0	0
60.0	0	0	0	76	270	495	581	726	820
	820	726	581	495	270	76	0	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 27

HORZ. ANGLES (H 1- 22)

VERT.	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
-84.0	2	5	6	5	4	8	9	11	9
-76.0	4	8	8	16	25	42	67	91	94
-68.0	6	10	24	56	85	155	182	206	229
-60.0	3	15	57	122	296	311	314	357	350
-52.0	8	29	182	654	1413	1285	1116	1184	1224
-44.0	8	44	155	2060	2382	2162	1942	1966	1959
-36.0	8	59	211	2579	2895	2757	2535	2460	2318
-28.0	8	75	604	2844	3431	3828	3768	3402	2866
-20.0	8	38	1153	3059	4542	5504	7034	6049	4616
-12.0	8	97	1931	3253	5687	7139	11176	10830	11209
-4.0	8	101	2304	3335	5901	7964	13641	13626	16532
4.0	8	99	2269	3328	5500	6007	13728	13561	16442
12.0	8	93	1828	3222	4872	7263	11322	11186	11347
20.0	8	82	943	3138	4145	5541	7194	6515	4465

VERT.	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
-84.0	9	11	9	8	4	6	5	5	2
-76.0	94	91	67	42	25	16	8	8	4
-68.0	229	206	182	156	85	56	24	10	6
-60.0	350	357	314	311	296	122	57	15	3
-52.0	1224	1184	1116	1285	1413	654	182	29	8
-44.0	1959	1966	1942	2162	2382	2060	155	44	8
-36.0	2318	2460	2535	2767	2895	2579	211	59	8
-28.0	2866	3402	3768	3828	3431	2844	604	75	8
-20.0	4616	6049	7034	5504	4542	3059	1153	38	8
-12.0	11209	10830	11176	7139	5687	3253	1931	97	8
-4.0	16532	13626	13641	7964	5901	3335	2304	101	8
4.0	16442	13561	13728	6007	5500	3328	2269	99	8
12.0	11347	11186	11322	7263	4872	3222	1828	93	8
20.0	4465	6515	7194	5541	4145	3138	943	82	8

856

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE [illegible] TABLE NO. 27

HORZ. ANGLES (H 18 22)

VERT.	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
28.0	8	68	265	2795	3445	3654	3773	3236	2725
36.0	4	53	193	2499	2927	2632	2410	2296	2143
44.0	8	39	145	1793	2375	2069	1779	1741	1706
52.0	8	26	98	421	1374	1227	975	980	967
60.0	8	16	53	126	250	252	233	258	249
68.0	6	10	24	54	96	138	171	193	204
76.0	4	8	11	19	33	55	85	105	116
84.0	2	5	4	4	10	14	60	76	17

VERT.	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
28.0	2725	3236	3773	3654	3445	2795	265	68	8
36.0	2143	2296	2410	2632	2927	2499	193	53	4
44.0	1706	1741	1779	2069	2375	1793	145	39	8
52.0	967	980	975	1227	1374	421	98	26	8
60.0	249	258	233	252	250	126	53	16	8
68.0	204	193	171	138	96	54	24	10	6
76.0	116	105	85	55	33	19	11	8	4
84.0	17	76	60	14	10	4	4	5	2

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: 4400122401 TABLE NO. 28

HORZ. ANGLES (H 18 15)

VERT.	73.0	75.0	77.0	79.0	81.0	83.0	85.0	87.0	89.0	91.0	93.0	95.0	97.0	99.0	101.0	103.0	105.0	107.0
-15.0	10088	12622	15194	18617	21277	24618	27255	27032	27032	27032	27032	27255	24618	21277	18617	15194	12622	10088
-13.0	11922	15326	18774	22163	27483	33410	39564	43600	44472	44472	43600	39564	33410	27483	22163	18774	15326	11922
-11.0	14674	18031	22349	28369	37234	47477	59786	67143	69759	69759	67143	59786	47477	37234	28369	22349	18031	14674
-9.0	16508	18933	25926	36348	48759	64182	78249	91559	98535	98535	91559	78249	64182	48759	36348	25926	18933	16508
-7.0	16508	21637	30395	44326	62057	80007	101108	120335	138647	138647	120335	101108	80007	62057	44326	30395	21637	16508
-5.0	17425	23440	35759	52305	71809	95833	126605	173526	223230	223230	173526	126605	95833	71809	52305	35759	23440	17425
-3.0	17425	27948	40229	60284	80674	103746	144189	244158	369724	369724	244158	144189	103746	80674	60284	40229	27948	17425
-1.0	19259	29751	45543	67376	87766	109900	155618	254622	458568	458568	254622	155618	109900	87766	67376	45543	29751	19259
1.0	21093	29751	43805	65603	82447	97591	130121	183350	263342	263342	183350	130121	97591	82447	65603	43805	29751	21093
3.0	21093	28850	41123	54965	71809	88799	112538	139519	189222	189222	139519	112538	88799	71809	54965	41123	28850	21093
5.0	20716	26145	35759	52305	69149	80886	91437	104639	129055	129055	104639	91437	80886	69149	52305	35759	26145	20716
7.0	19259	24342	32183	41667	54078	65940	75611	84583	93303	93303	84583	75611	65940	54078	41667	32183	24342	19259
9.0	17425	20736	25925	31915	40780	50114	60665	69759	73247	73247	69759	60665	50114	40780	31915	25925	20736	17425
11.0	13757	18031	20551	24823	30142	37806	45718	55808	61039	61039	55808	45718	37806	30142	24823	20551	18031	13757

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: 5400S22U01 TABLE NO. 28

HORZ. ANGLES (H 1R 1N)									
		73.0	75.0	77.0	79.0	81.0	83.0	85.0	87.0	89.0
	91.0	93.0	95.0	97.0	99.0	101.0	103.0	105.0	107.0	
VERT.										
13.0		11005	14425	16986	18617	23050	28134	33410	34240	41856
	41856	34240	33410	28134	23050	18617	16986	14425	11005	
15.0		10088	10819	13410	15958	17731	20222	30772	27904	29648
	29648	27904	30772	20222	17731	15958	13410	10819	10088	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H250576BE1 TABLE NO. 29

HORZ. ANGLES (H 18 14)

VERT.									
	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
-85.0	0	0	128	459	1709	2168	2754	3621	3494
	3494	3621	2754	2168	1709	459	128	0	0
-75.0	0	77	332	1964	2754	4412	5075	3876	3035
	3035	3876	5075	4412	2754	1964	332	77	0
-65.0	0	204	1250	2499	3749	5916	4412	3417	3162
	3162	3417	4412	5916	3749	2499	1250	204	0
-55.0	0	204	2372	2831	4998	8951	4616	4157	3825
	3825	4157	4616	8951	4998	2831	2372	204	0
-45.0	0	255	2576	3162	6962	15453	7038	5661	5330
	5330	5661	7038	15453	6962	3162	2576	255	0
-35.0	0	204	2703	3417	8543	15122	9869	8415	8492
	8492	8415	9869	15122	8543	3417	2703	204	0
-25.0	0	255	2703	3366	7956	12954	13286	11118	14153
	14153	11118	13286	12954	7956	3366	2703	255	0
-15.0	0	204	2423	3086	5202	8874	9333	10736	15122
	15122	10736	9333	8874	5202	3086	2423	204	0
-5.0	0	204	2244	2831	3672	5749	6579	7625	8619
	8619	7625	6579	5749	3672	2831	2244	204	0
5.0	0	204	2040	2499	2831	3494	3621	4157	4539
	4539	4157	3621	3494	2831	2499	2040	204	0
15.0	0	128	1122	2168	2372	2499	2576	2703	3035
	3035	2703	2576	2499	2372	2168	1122	128	0
25.0	0	128	128	1836	1964	1964	1964	1913	1836
	1836	1913	1964	1964	1964	1836	128	128	0
35.0	0	0	128	867	1326	1250	1173	1046	995
	995	1046	1173	1250	1326	867	128	0	0
45.0	0	0	0	0	128	128	128	128	128
	128	128	128	128	128	0	0	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V400S25[illegible]E1 TABLE NO. 30

HORZ. ANGLES (V 50 90)

	2.5	5.0	7.5	12.5	15.0	17.5	22.5	25.0	27.5
32.5	35.0	37.5	45.0	65.0	85.0	90.0	95.0	115.0	135.0
142.5	145.0	148.5	152.5	155.0	157.5	162.5	165.0	167.5	172.5
175.0	177.5	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0
207.5	212.5	215.0	225.0	245.0	255.0	270.0	285.0	305.0	315.0
325.0	327.5	332.5	335.0	337.5	342.5	345.0	347.5	352.5	355.0
357.5									

VERT.

0.0		1120	1120	1120	1120	1120	1120	1120	1120	1126
	1062	1011	790	527	527	527	[illegible]	527	527	527
	790	1011	1062	1126	1120	1120	1120	1120	1120	1120
	1120	1120	1120	958	790	769	593	593	593	527
	527	527	527	527	527	527	527	527	527	527
	527	527	527	527	593	593	593	769	790	958
	1120									
2.5		1262	1325	1383	1383	1415	1449	1515	1515	1515
	1317	1250	988	659	564	564	527	564	564	659
	988	1250	1317	1515	1515	1515	1449	1415	1383	1383
	1325	1262	1120	1120	1120	939	705	707	593	527
	527	527	527	527	527	527	527	527	527	527
	527	527	527	527	593	707	705	939	1120	1120
	1120									
5.0		1647	1702	1779	2086	2043	2371	2371	2371	2412
	1977	1515	1317	790	593	593	564	593	593	790
	1317	1515	1977	2412	2371	2371	2371	2043	2086	1779
	1702	1647	1515	1372	1186	1120	1043	942	676	593
	593	593	593	593	593	593	593	593	593	593
	593	593	593	593	676	942	1043	1120	1186	1372
	1515									
7.5		3360	3830	4151	4814	4575	4523	4282	3935	3836
	2701	1861	1713	1053	808	670	593	670	808	1053
	1713	1861	2701	3836	3935	4282	4523	4575	4814	4151
	3830	3360	2503	2021	1735	1449	1245	1101	942	851
	790	725	707	740	725	725	725	725	725	740
	707	726	790	851	942	1101	1245	1449	1735	2024
	2503									
10.0		6556	7235	7774	8367	8086	8037	7180	5500	5995
	3559	2207	1911	1317	1021	940	940	940	1021	1317
	1911	2207	3558	5995	5500	7180	8037	8086	8367	7774
	7235	6556	4743	4362	4145	2305	1966	1647	1317	1255
	1186	1120	1120	1120	856	856	856	856	856	1120
	1120	1120	1186	1255	1317	1647	1968	2305	4145	4362
	4743									

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V400S25SE1 TABLE NO. 30

HORZ. ANGLES (V 60 20)

	2.5	5.0	7.5	12.5	15.0	17.5	22.5	25.0	27.5
32.5	35.0	37.5	45.0	65.0	85.0	90.0	95.0	115.0	135.0
142.5	145.0	148.5	152.5	155.0	157.5	162.5	165.0	167.5	172.5
175.0	177.5	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0
207.5	212.5	215.0	225.0	235.0	255.0	270.0	285.0	305.0	315.0
325.0	327.5	332.5	335.0	337.5	342.5	345.0	347.5	352.5	355.0
357.5									

VERT.

12.5		11920	12450	13770	14610	13930	13240	10150	7065	6286
	3886	2552	2043	1581	1235	989	989	989	1235	1581
	2043	2552	3886	6286	7065	10150	13240	13930	14160	13770
	12450	11920	9222	7447	6720	4480	3724	3030	2110	1894
	1845	1449	1330	1251	988	988	988	988	988	1251
	1330	1449	1845	1894	2110	3030	3724	4480	6720	7447
	9222									
15.0		18640	21810	21610	22200	21210	18970	11790	8630	6390
	3492	2898	2503	1845	1449	1064	1064	1064	1449	1845
	2503	2898	3492	6390	8630	11790	18970	21210	22200	21610
	21810	18640	15350	14230	11660	8564	7576	5665	3228	2767
	2371	1647	1449	1186	1120	1120	1155	1121	1120	1186
	1449	1647	2371	2767	3228	5665	7576	8564	11660	14230
	15350									
17.5		29310	24050	30630	26480	21050	18970	11130	8877	6390
	4084	3935	3294	2733	1861	1317	1317	1317	1861	2733
	3294	3835	4084	6390	8877	11130	18970	21050	26480	30800
	24050	29310	25030	16580	19500	19490	8203	9882	5271	3129
	3030	1977	1663	1350	1350	1350	1449	1350	1350	1350
	1663	1977	3030	3129	5271	9882	8203	19490	19500	16580
	25030									
20.0		33470	26290	32480	26550	20880	18120	10540	9124	6456
	4743	4775	4018	3620	2272	1543	1460	1543	2272	3626
	4018	4775	4743	6456	9124	10540	10120	20888	26550	32480
	26290	33470	29640	16710	23510	16860	8828	11000	4875	3492
	3096	1977	1877	1515	1960	1581	1713	1581	1460	1515
	1877	1977	3096	3492	4875	11000	8828	16960	23510	18710
	29640									
22.5		32740	28530	31360	25692	20720	18450	11560	9377	7642
	6258	5714	5665	4512	2684	2128	1543	2128	2684	4512
	5665	5714	6258	7642	9377	11660	18450	20720	25692	31360
	28530	32740	29970	20950	23580	16860	9454	10670	5665	3896
	3492	2503	2091	1618	1663	1812	1976	1812	1663	1618
	2091	2503	3492	3896	5665	10670	9454	16860	23580	20950
	29970									

B62

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CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V400S2S4E1 TABLE NO.  30



HORZ. ANGLES   (V    60 . 70)
             2.5    5.0    7.5   12.5   15.0   17.5   22.5   25.0   27.5
      32.5  35.0   37.5   45.0   65.0   85.0   90.0   95.0  115.0  135.0
     142.5 145.0  148.5  152.5  155.0  157.5  162.5  165.0  167.5  172.5
     175.0 177.5  182.5  185.0  187.5  192.5  195.0  197.5  202.5  205.0
     207.5 212.5  215.0  225.0  235.0  255.0  270.0  285.0  305.0  315.0
     325.0 327.5  332.5  335.0  337.5  342.5  345.0  347.5  352.5  355.0
     357.5
VERT.

25.0         31820  31820  29640  23780  20550  17000  11590   9616   5598
      7114  6654   6456   5401   3096   2371   2125   2371   3096   5401
      6456  6654   7114   8598   9616  11590  17000  20550  23780  29640
     31820 31820  28790  23190  22270  15220  10080   9289   4743   4216
      3426  2603   2305   1845   1845   2043   2240   2043   1845   1845
      2305  2603   3426   4216   4743   9289  10030  15220  22270  23190
     28790

27.5         27930  27930  25930  21490  18930  16600  12520   9970   9289
      7312  6784   6654   5467   3886   3511   2371   3511   3886   5467
      6654  6784   7312   9289   9970  12520  16600  18930  21490  25930
     27930 27930  26090  20200  20100  13770   9289   8169   4875   4018
      3360  2833   2437   1976   1976   2106   2240   2106   1976   1976
      2437  2833   3360   4018   4875   8169   9289  13770  20100  20200
     26090

30.0         25160  25160  23780  19760  17300  15680  11920  10320   9827
      6917  6916   6917   5533   4677   4256   3511   4256   4677   5533
      6917  6916   6917   9827  10320  11920  15680  17300  19760  23780
     25160 25160   2220  17220  16800  11400   8498   7246   4342   3819
      3162  2833   2569   2108   2106   2174   2240   2174   2106   2108
      2569  2833   3162   3819   4348   7246   8498  11400  16800  17220
      2220

35.0         16070  16070  16560  16120  15680  14010  12340  10670   8861
      7410  7048   6596   5599   5467   4743   4256   4743   5467   5599
      6596  7048   7410   8861  10670  12340  14010  15680  16120  16560
     16070 16070  15150  14230  12060   9883   7708   6346   4984   3624
      3316  3009   2701   2240   2240   2240   2240   2240   2240   2240
      2701  3009   3316   3624   4984   6346   7708   9883  12060  14230
     15150

45.0         12820  12820  13920  14080  14230  13320  12430  11530  10705
     10030  9882   9043   7312   6061   5271   4743   5271   6061   7312
      9043  9882  10030  10705  11530  12430  13320  14230  14080  13920
     12820 12820  11880  10940   9970   3684   8037   6982   5928   4875
      4215  3557   2898   2503   2240   2240   2240   2240   2240   2503
      2898  3557   4215   4875   5928   6982   8037   3684   9970  10940
     11880
```

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V400SP5RE1 TABLE NO. 30

HORZ. ANGLES (V 60 20)

		2.5	5.0	7.5	12.5	15.0	17.5	22.5	25.0	27.5
	32.5	35.0	37.5	45.0	65.0	85.0	90.0	95.0	115.0	135.0
	142.5	145.0	147.5	152.5	155.0	157.5	162.5	165.0	167.5	172.5
	175.0	177.5	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0
	207.5	212.5	215.0	225.0	235.0	255.0	270.0	285.0	305.0	315.0
	325.0	327.5	332.5	335.0	337.5	342.5	345.0	347.5	352.5	355.0
	357.5									
VERT.										
55.0		10610	10610	11550	12030	12520	12570	12520	12970	12189
	11545	11396	10640	9091	7444	6324	5271	6324	7444	9091
	10640	11396	11515	12189	12970	12520	12570	12520	12030	11550
	10610	10610	10140	9684	9112	8541	7971	7224	6477	5647
	4918	4106	3294	2437	2240	2240	2305	2240	2240	2437
	3294	4106	4918	5647	6477	7224	7971	8541	9112	9684
	10140									
65.0		10010	10010	10540	10670	10800	10783	10760	10740	10441
	10200	10415	10000	9750	9552	8504	6384	8504	9552	9750
	10080	10145	10200	10441	10740	10760	10783	10800	10670	10540
	10010	10010	9620	9223	8696	8170	7642	7048	6456	5863
	5358	4852	4348	2898	2513	2174	2106	2174	2513	2898
	4348	4852	5358	5863	6456	7048	7642	8170	8696	9223
	9620									
75.0		9440	9440	9771	9860	9950	10010	10080	10150	10211
	10270	10277	10320	10408	10670	9616	8504	9616	10670	10408
	10320	10277	10270	10211	10150	10080	10010	9950	9860	9771
	9440	9440	9201	8959	8739	8521	8301	8037	7729	7444
	7180	6916	6654	6051	5401	4345	4242	4345	5401	6051
	6654	6916	7180	7444	7729	8037	8301	8521	8739	8959
	9201									
85.0		10630	10670	10720	10750	10800	10830	10850	10870	10936
	10990	11000	10960	10940	10740	9583	9416	9583	10740	10940
	10960	11000	10990	10936	10870	10850	10830	10800	10760	10720
	10670	10620	10580	10540	10450	10370	10280	10250	10230	10210
	10190	10170	10150	9816	9684	9355	9421	9355	9684	9816
	10150	10170	10190	10210	10230	10250	10280	10370	10450	10540
	10580									
90.0		10630	10670	10720	10760	10800	10830	10850	10870	10936
	10990	11000	10960	10940	10740	10540	10540	10540	10740	10940
	10960	11000	10990	10936	10870	10850	10830	10800	10760	10720
	10670	10630	10580	10540	10450	10370	10280	10250	10230	10210
	10190	10170	10150	9816	9684	9355	9421	9355	9684	9816
	10150	10170	10190	10210	10230	10250	10280	10370	10450	10540
	10580									

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V1UCS5MGE1 TABLE NO. 31

HORZ. ANGLES (V 2 10)

VERT.	0.0	360.0
5.0	3460	3460
15.0	11245	11245
25.0	19030	19030
35.0	25950	25950
45.0	22490	22490
55.0	14270	14270
65.0	9080	9080
75.0	6490	6490
85.0	6920	6920
90.0	9080	9080

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: 4102565401 TABLE NO. 32

HORZ. ANGLES (H 19 19)

VERT.										
		0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0
	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
-90.0		1613	1538	1288	1026	732	438	263	207	182
	225	182	207	263	438	732	1026	1288	1538	1613
-80.0		1613	1900	1980	1750	1300	990	735	530	495
	525	495	530	735	990	1300	1750	1980	1900	1613
-70.0		1613	2250	2650	2860	2900	2400	1961	1629	1355
	1375	1355	1629	1961	2400	2900	2860	2650	2250	1613
-60.0		1613	2400	3490	4410	4500	4050	3100	3800	4000
	3975	4000	3800	3100	4050	4500	4410	3490	2400	1613
-50.0		1613	2980	4350	6200	7750	7600	7825	8400	8500
	8425	8500	8400	7825	7600	7750	6200	4350	2980	1613
-40.0		1613	3300	5350	8027	10994	11000	14000	15400	15140
	14875	15140	15400	14000	11000	10994	8027	5350	3300	1613
-30.0		1613	3600	6550	10200	14000	17400	23080	23650	22700
	22725	22700	23650	23080	17400	14000	10200	6550	3600	1613
-20.0		1613	3900	7250	11700	17360	26000	34350	35350	35500
	36700	35500	35350	34350	26000	17360	11700	7250	3900	1613
-10.0		1613	3940	7700	13150	20500	35000	49500	60250	64000
	69325	64000	60250	49500	35000	20500	13150	7700	3940	1613
0.0		1613	3957	7756	13294	21263	36725	67388	98676	124431
	169056	124431	98676	67388	36725	21263	13294	7756	3957	1613
10.0		1613	3900	7550	12890	20190	36400	52965	58440	63900
	66250	63900	58440	52965	36400	20190	12890	7550	3900	1613
20.0		1613	3820	6960	11350	16920	28340	39660	35060	36190
	35875	36190	35060	39660	28340	16920	11350	6960	3820	1613
30.0		1613	3475	6200	9740	13400	17600	24000	21520	21560
	21800	21560	21520	24000	17600	13400	9740	6200	3475	1613
40.0		1613	3170	5030	7630	10510	10700	13700	12760	13500
	13325	13500	12760	13700	10700	10510	7630	5030	3170	1613

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 32

HORZ. ANGLES (H 19 - 19)

VERT.	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0
50.0	1613	2630	4050	5830	7400	7140	7245	7390	7650
60.0	1613	2770	3205	4100	4200	3800	2950	3500	3700
70.0	1613	2070	2400	2630	2700	2250	1840	1530	1290
80.0	1613	1700	1740	1595	1200	930	680	500	465
90.0	1613	1350	1103	919	644	400	238	200	194

VERT.	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
50.0	7450	7650	7390	7245	7140	7400	5830	4050	2630	1613
60.0	3550	3700	3500	2950	3800	4200	4100	3205	2770	1613
70.0	1325	1290	1530	1840	2250	2700	2630	2400	2070	1613
80.0	450	465	500	680	930	1200	1595	1740	1700	1613
90.0	150	194	200	238	400	644	919	1103	1350	1613

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V25553A4E2 TABLE NO. 33

```
HORZ. ANGLES  (V   51   15)
           0.0    5.0   10.0   15.0   20.0   25.0   30.0   35.0   40.0
   50.0   60.0   70.0   80.0   90.0  100.0  110.0  120.0  130.0  140.0
  145.0  150.0  155.0  160.0  165.0  170.0  175.0  180.0  185.0  190.0
  195.0  200.0  205.0  210.0  220.0  230.0  240.0  250.0  260.0  270.0
  280.0  290.0  300.0  310.0  320.0  330.0  335.0  340.0  345.0  350.0
  355.0  360.0
VERT.

-40.0          160    170    170    170    170    170    170    170    160
         170   170    160    160    150    160    160    170    170    150
         170   170    170    170    170    170    170    160    160    160
         150   150    140    130    125    120    120    100    100    100
         100   100    120    120    125    130    140    150    150    160
         160   160

-30.0          227    227    227    227    205    205    200    200    200
         200   220    220    200    200    200    220    220    200    200
         200   200    205    205    227    227    227    227    220    205
         205   190    180    170    160    150    150    140    140    140
         140   140    150    150    160    170    180    190    205    205
         220   227

-20.0          300    300    300    300    260    280    260    260    270
         250   270    270    250    220    250    270    270    250    270
         260   260    280    280    300    300    300    300    300    280
         260   240    220    205    205    200    190    175    175    160
         175   175    190    200    205    205    220    240    260    280
         300   300

-10.0          350    400    400    400    390    330    390    400    475
         410   325    325    325    325    325    325    325    410    475
         400   390    390    390    400    400    400    350    350    325
         325   300    250    240    250    240    220    205    205    205
         205   205    220    240    250    240    250    300    325    325
         350   350

  0.0          600    600    600    630   1000   1000   1000   1000   1000
         630   400    400    410    445    410    400    400    630   1000
        1000  1000   1000   1000    630    600    600    600    515    400
         390   360    350    325    325    325    250    235    235    232
         235   235    250    325    325    325    350    360    340    400
         515   600

  2.5          630    645   1000   1600   2500   3250   2500   2050   1300
         815   515    476    458    442    458    476    515    815   1300
        2050  2500   3250   2500   1600   1600    545    530    500    515
         440   400    375    360    345    345    287    250    250    250
         250   250    287    345    345    360    375    400    440    515
         600   630
```

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V25 [illegible] TABLE NO. 33

HORZ. ANGLES (V [illegible] 18)

		0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0
	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0
	145.0	150.0	155.0	160.0	165.0	170.0	175.0	180.0	185.0	190.0
	195.0	200.0	205.0	210.0	220.0	230.0	240.0	250.0	260.0	270.0
	280.0	290.0	300.0	310.0	320.0	330.0	335.0	340.0	345.0	350.0
	355.0	360.0								
VERT.										
5.0		2050	2875	4000	6300	7145	6300	5150	3250	2500
	1000	630	552	530	535	530	552	530	1000	2500
	3250	5150	6300	7145	6300	4000	2875	2050	1300	630
	555	515	450	400	365	365	324	300	325	400
	325	300	324	365	365	400	450	515	555	630
	1300	2050								
7.5		3250	6300	7990	8995	10000	7990	6300	4000	3250
	1300	815	630	587	584	587	630	815	1300	3250
	4000	6300	7990	10000	8995	7990	6300	3250	2050	1200
	815	630	555	515	385	385	361	350	400	460
	400	350	361	385	385	515	555	630	515	1200
	2050	3250								
10.0		6300	8995	10000	10650	11000	10000	7990	5150	3500
	1600	1000	815	630	600	630	815	1000	1600	3500
	5150	7990	10000	11000	10650	10000	8995	6300	2500	1600
	1000	815	720	555	400	400	400	400	515	515
	515	400	400	400	400	555	720	815	1000	1600
	2500	6300								
15.0		7145	10000	11830	12750	12750	11900	9330	7145	4575
	2500	1900	1600	1000	1000	1000	1600	1900	2500	4575
	7145	9330	11900	12750	12750	11830	10000	7145	4000	2500
	1600	1200	1000	815	630	630	630	630	630	815
	630	630	630	630	630	815	1000	1200	1600	2500
	4000	7145								
20.0		7145	9330	11900	13670	14125	12750	9330	7145	5825
	3250	2500	2050	2050	1900	2050	2050	2500	3250	5825
	7145	9330	12750	14125	13670	11900	9330	7145	4000	3000
	2200	1600	1300	1200	1000	1000	1000	1000	1000	1000
	1000	1000	1000	1000	1000	1000	1300	1500	2200	3000
	4000	7145								
30.0		5540	7145	8650	11000	12750	12750	10000	8995	7145
	4770	3250	3250	3250	2500	3250	3250	3250	4770	7145
	8995	10000	12750	12750	11000	8650	7145	5540	4000	3000
	2275	1825	1500	1200	1100	1100	1100	1100	1100	1100
	1100	1100	1100	1100	1100	1200	1500	1825	2275	3000
	4000	5540								

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMI [illegible] TABLE NO. 33

```
HORZ. ANGLES  (V   51   19)
                0.0    5.0   10.0   15.0   20.0   25.0   30.0   35.0   40.0
  50.0   60.0  70.0   80.0   90.0  100.0  110.0  120.0  130.0  140.0
 145.0  150.0 155.0  160.0  165.0  170.0  175.0  180.0  185.0  190.0
 195.0  200.0 205.0  210.0  220.0  230.0  240.0  250.0  260.0  270.0
 280.0  290.0 300.0  310.0  320.0  330.0  335.0  340.0  345.0  350.0
 355.0  360.0
VERT.

 40.0          5260   5725   7145   8660  10000  10000  10000   9330   8660
        6300   5150   4575   4380   4000   4380   4575   5150   6300   8660
        9330  10000  10000  10000   8660   7145   5725   5260   4000   3000
        2275   1825   1500   1400   1200   1200   1200   1200   1200   1200
        1200   1200   1200   1200   1200   1400   1500   1825   2275   3000
        4000   5260

 50.0          4575   5150   5725   6860   7990   7990   8500   8390   8390
        7145   7000   6300   5940   5840   5840   6300   7000   7145   8390
        8390   8500   7990   7990   6860   5725   5150   4575   3500   3000
        2275   1900   1500   1400   1300   1300   1300   1300   1300   1300
        1300   1300   1300   1300   1300   1400   1500   1900   2275   3000
        3500   4575

 60.0          3500   4000   4575   5150   5530   6300   6300   6300   6870
        7250   7500   7500   7250   7250   7250   7500   7500   7250   6870
        6300   6300   6300   5530   5150   4575   4000   3500   3000   2640
        2200   1900   1500   1400   1400   1400   1400   1400   1400   1400
        1400   1400   1400   1400   1400   1400   1500   1900   2200   2640
        3000   3500

 70.0          3000   3250   3500   4000   4575   5530   5150   5150   5540
        6300   7000   7000   7000   7000   7000   7000   7000   6300   5540
        5150   5150   5530   4575   4000   3500   3250   3000   2800   2500
        2050   1900   1600   1500   1500   1500   1500   1500   1500   1500
        1500   1500   1500   1500   1500   1500   1600   1900   2050   2500
        2800   3000

 80.0          3000   3250   3500   3625   3810   4100   4575   4770   5150
        5530   5840   6300   6300   6300   6300   6300   5840   5530   5150
        4770   4575   4100   3810   3625   3500   3250   3000   2720   2700
        2500   2200   1900   2050   1600   1600   1600   1600   1600   1600
        1600   1600   1600   1600   1600   2050   1900   2200   2500   2700
        2720   3000

 90.0          3000   3000   3000   3000   3000   3000   3000   3000   3000
        3000   3000   3000   3000   3000   3000   3000   3000   3000   3000
        3000   3000   3000   3000   3000   3000   3000   3000   3000   3000
        3000   3000   3000   3000   3000   3000   3000   3000   3000   3000
        3000   3000   3000   3000   3000   3000   3000   3000   3000   3000
        3000   3000
```

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 34

HORZ. ANGLES (V 38 (7)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
-35.0		0	0	0	0	0	0	75	80	95
	90	90	85	30	75	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	
-25.0		75	110	125	110	130	105	135	160	175
	185	185	175	160	135	105	130	110	125	110
	75	95	95	85	90	75	0	0	0	0
	0	0	75	90	85	95	90	75	110	
-15.0		160	160	200	210	215	220	210	220	260
	320	320	260	220	210	225	215	210	200	160
	160	175	190	205	230	165	150	105	75	75
	105	150	185	230	205	190	175	150	160	
-5.0		265	260	370	390	425	425	370	360	390
	425	425	390	360	370	425	425	390	370	260
	265	260	345	365	410	330	225	205	185	195
	205	225	330	410	355	345	250	255	260	
5.0		425	450	630	430	440	1075	730	625	630
	820	820	630	625	780	1075	940	530	630	450
	430	460	500	575	610	450	410	390	360	350
	390	410	450	510	575	500	450	430	450	
10.0		530	610	1075	1725	2550	2700	1525	1075	1000
	1100	1100	1000	1075	1525	2700	2550	1725	1075	610
	530	490	570	515	720	530	510	450	460	460
	450	510	530	720	615	570	490	530	610	
15.0		638	800	3800	8500	13000	8500	3000	2300	1700
	1785	1785	1700	2300	3000	8500	13000	8500	3800	800
	638	625	635	660	830	610	610	605	570	570
	605	610	610	630	660	635	525	535	590	
20.0		1125	1525	7000	11500	13500	10000	5300	3300	3000
	2550	2550	3000	3300	5300	10000	14500	11500	7000	1525
	1125	930	850	860	850	575	540	700	575	675
	700	540	675	850	860	850	930	1125	1525	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 34

HORZ. ANGLES (V 33 17)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
25.0		2200	2600	5900	4000	10200	4900	6400	4400	4700
	4900	4900	4700	4400	6200	4500	10200	9000	5100	2600
	2200	1275	1125	1075	1100	910	940	930	930	930
	930	940	910	1100	1075	1125	1275	2200	2600	
30.0		2575	3000	4900	7600	7700	7600	6400	6100	6700
	7650	7650	6700	6100	6400	7600	7700	7600	4900	3000
	2575	2600	1775	1260	1200	1080	1110	1160	1150	1150
	1160	1110	1080	1200	1260	1775	2600	2575	3000	
35.0		2700	3500	4500	4900	5100	6200	6400	7500	7700
	7750	7750	7700	7500	6900	6200	5100	4900	4500	3500
	2700	2800	2100	1525	1375	1275	1295	1380	1350	1350
	1380	1295	1275	1375	1525	2100	2800	2700	3500	
45.0		2700	3900	4200	4800	5500	6500	7600	7750	7800
	7800	7800	7800	7750	7660	6600	5500	4800	4200	3900
	2700	3000	2650	2300	1900	1600	1580	1560	1640	1640
	1660	1680	1600	1900	2300	2650	3000	2700	3900	
55.0		2660	2800	4000	4800	5500	5800	6500	7400	7650
	7700	7700	7650	7400	5600	5800	5500	4800	4000	2800
	2660	2575	2400	2200	1800	1790	1800	1820	1825	1825
	1820	1800	1790	1800	2200	2400	2575	2660	2800	
65.0		1975	2500	3300	3600	4300	4500	5100	5500	6010
	6300	6300	6010	5500	5100	4500	4300	3600	3300	2500
	1975	1950	1785	2200	2100	1990	2100	2100	2050	2050
	2100	2100	1990	2100	2200	1785	1950	1975	2500	
75.0		2100	2400	2700	2900	3400	3700	4000	4300	4450
	4600	4600	4450	4300	4000	3700	3400	2900	2700	2400
	2100	2180	2150	2100	2250	2240	2310	2330	2310	2310
	2330	2310	2290	2250	2100	2150	2180	2100	2400	
85.0		2400	2500	2575	2700	2800	2850	2900	3000	3150
	3300	3300	3150	3000	2900	2850	2800	2700	2575	2500
	2400	2400	2400	2400	2450	2475	2500	2500	2490	2490
	2500	2500	2475	2450	2400	2400	2400	2400	2500	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] TABLE NO. 34

HORZ. ANGLES (V 3H 17)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
90.0		2805	2805	2805	2805	2805	2805	2805	2805	2805
	2805	2805	2805	2805	2805	2805	2805	2805	2805	2805
	2805	2805	2805	2805	2805	2805	2805	2805	2805	2805
	2805	2805	2805	2805	2805	2805	2805	2805	2805	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 35

HORZ. ANGLES (V 37 16)

VERT.										
		5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0	185.0
	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0	285.0
	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0		
-25.0		110	75	60	40	20	40	40	50	50
	50	50	40	40	20	40	50	75	110	100
	102	60	50	0	0	0	0	0	0	0
	0	0	0	50	0	102	100	110		
-15.0		175	175	170	150	145	135	130	125	125
	125	125	130	155	145	150	170	175	175	215
	245	205	165	140	125	100	95	50	50	95
	100	125	140	165	205	245	215	175		
-5.0		330	360	340	250	250	240	240	185	185
	185	185	240	240	250	260	340	360	360	405
	445	375	300	275	250	260	250	300	300	250
	265	260	275	300	375	445	405	380		
5.0		900	890	640	560	520	460	445	360	340
	340	360	445	460	520	560	640	890	900	840
	634	625	520	495	470	460	455	500	500	455
	460	470	495	520	625	634	840	900		
10.0		2550	2550	2550	1225	750	600	590	450	425
	425	450	550	600	750	1225	2550	2550	2550	2550
	1925	940	620	560	550	560	570	580	560	570
	560	550	580	620	940	1925	2550	2550		
15.0		9000	10100	5500	2200	1260	930	630	560	520
	520	560	630	930	1260	2200	5500	10100	9000	5225
	2200	1220	890	720	645	700	800	790	790	800
	700	645	720	890	1220	2200	5225	9000		
20.0		9000	10200	6500	3900	2350	1575	1050	635	570
	570	635	1050	1575	2350	3900	6500	10200	9000	5500
	3400	1850	1250	840	820	1075	1200	1125	1125	1200
	1075	820	840	1250	1850	3400	5500	9000		
25.0		7500	8000	6400	4300	3000	1800	1180	840	760
	760	840	1130	1800	3000	4300	6400	8000	7500	5500
	3700	2400	1525	1210	1230	1440	1525	1525	1625	1625
	1440	1230	1210	1525	2400	3700	5500	7500		

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] TABLE NO. 35

HORZ. ANGLES (V 37 [illegible])

		5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0
	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0	185.0
	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0	285.0
	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0		
VERT.										
30.0		6200	6400	6000	5100	4300	2600	1500	1045	1075
	1075	1045	1500	2600	4300	5100	5000	5400	6200	5460
	4300	2600	1740	1400	1400	1750	2350	2300	2300	2350
	1750	1400	1400	1790	2600	4300	5460	5200		
35.0		5500	5425	5325	5500	5370	3700	2100	1650	1550
	1550	1650	2100	3700	5370	5500	5325	5425	5500	5425
	4400	3400	2150	1640	1685	1950	2300	2700	2700	2300
	1950	1685	1650	2150	3400	4400	5425	5500		
45.0		5100	5075	5355	5525	5500	5225	4300	3300	3100
	3100	3300	4300	5225	5500	5525	5355	5075	5100	5350
	4800	3500	2400	2050	1975	2025	2400	2750	2750	2400
	2025	1975	2050	2400	3500	4800	5350	5100		
55.0		5550	5650	5800	6000	5750	5500	5400	5050	5050
	5050	5050	5400	5500	5750	6000	5800	5650	5550	5425
	5200	3900	2800	2465	2360	2375	2400	2500	2600	2400
	2375	2360	2465	2800	3800	5200	5425	5550		
65.0		5400	5475	5525	5750	5850	6000	5500	5650	5600
	5600	5650	5800	6000	5850	5750	5525	5475	5400	5050
	4800	4000	3400	3150	2700	2600	2550	3100	3100	2550
	2600	2700	3150	3400	4000	4800	5050	5400		
75.0		4800	5075	5225	5425	5375	5440	5450	5460	5470
	5470	5460	5450	5440	5375	5425	5225	5075	4800	4750
	4670	4100	3850	3700	3500	3500	3500	3700	3700	3500
	3500	3500	3700	3850	4100	4670	4750	4800		
85.0		4500	4550	4650	4700	4700	4540	4600	4700	4750
	4750	4700	4600	4640	4700	4700	4550	4550	4500	4470
	4400	4200	4175	4100	4000	3950	4000	4100	4100	4000
	3950	4000	4100	4175	4200	4400	4470	4500		
90.0		4310	4310	4310	4310	4310	4310	4310	4310	4310
	4310	4310	4310	4310	4310	4310	4310	4310	4310	4310
	4310	4310	4310	4310	4310	4310	4310	4310	4310	4310
	4310	4310	4310	4310	4310	4310	4310	4310		

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMI[illegible] V410 [illegible] TABLE NO. 36

HORZ. ANGLES (V 3H 17)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
-35.0		125	150	145	140	135	125	130	135	150
	175	175	150	135	130	125	135	140	145	150
	125	100	90	70	40	0	0	0	0	0
	0	0	0	40	70	90	100	125	150	
-25.0		250	270	275	280	285	275	275	280	310
	375	375	310	280	275	275	265	260	275	270
	250	230	200	180	175	150	105	90	40	40
	90	105	160	175	180	200	230	250	270	
-15.0		375	405	420	410	450	430	420	425	410
	490	490	410	425	420	430	430	410	420	405
	375	355	350	345	330	340	320	260	190	180
	260	320	390	340	345	350	355	375	405	
-5.0		500	600	700	750	775	850	780	750	875
	1060	1060	875	750	790	850	775	750	700	600
	500	500	550	575	600	550	450	400	360	360
	400	450	550	600	575	550	500	500	600	
5.0		750	1000	1750	2250	3100	3750	2200	1875	1900
	2200	2200	1900	1375	2200	3750	3100	2250	1750	1000
	750	775	810	840	825	750	550	525	500	500
	625	650	750	825	840	810	775	750	1000	
10.0		835	1250	3750	9500	17000	13000	4800	3400	3000
	3300	3300	3000	3400	4800	13000	17000	9500	3750	1250
	835	825	860	950	1000	840	800	775	750	750
	775	900	840	1000	950	860	825	835	1250	
15.0		1125	2600	17000	33500	30000	16000	10200	5200	4350
	4100	4100	4350	5200	10200	16000	30000	33500	17000	2600
	1125	1020	1000	1175	1275	950	900	950	925	925
	950	900	950	1275	1175	1000	1020	1125	2600	
20.0		2200	7000	20000	27000	24000	17500	10000	7500	6650
	7000	7000	6650	7500	10000	17500	24000	27000	20000	7000
	2200	1560	1500	1550	1550	1125	1050	1125	1125	1125
	1125	1050	1125	1550	1550	1500	1560	2200	7000	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMI[illegible] TABLE NO. 35

HORZ. ANGLES	(V	38	17)							
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
25.0		2300	7000	14000	14000	14000	14500	10500	9200	9200
	12500	12500	9200	9200	10500	14500	14000	14000	14000	7000
	4300	2500	2250	2100	1850	1350	1400	1450	1500	1500
	1450	1400	1350	1850	2100	2250	2500	4300	7000	
30.0		5575	8000	11000	14000	14500	13000	12500	12500	13750
	16000	16000	13750	12500	12500	13000	14500	14000	11000	8000
	5575	5000	4025	2600	2100	1875	1800	1875	1925	1925
	1875	1800	1875	2100	2600	4025	5000	5575	8000	
35.0		6800	8200	9200	10200	12700	12500	14500	16000	15500
	17800	17800	16500	16000	14500	12500	12700	10200	9200	8200
	6800	5575	4900	3700	2800	2450	2400	2450	2475	2475
	2450	2400	2450	2800	3700	4900	5575	6800	8200	
45.0		6800	7600	8300	9300	11250	12500	14500	17000	17200
	16800	16800	17200	17000	14500	12500	11250	9300	8300	7600
	6800	5900	5250	4400	3700	3100	2900	2525	2700	2700
	2625	2900	3100	3700	4400	5250	5900	6800	7600	
55.0		5600	5750	7600	8600	9700	10400	12250	14000	14750
	15000	15000	14750	14000	12250	10400	9700	8600	7600	5750
	5600	5150	4750	4300	3900	3450	3250	3100	3000	3000
	3100	3250	3450	3900	4300	4750	5150	5600	5750	
65.0		4750	4900	5500	7800	8500	9000	9500	10500	11250
	12000	12000	11250	10500	9500	9000	8500	7800	5500	4900
	4750	4650	4300	4100	3950	3650	3600	3425	3350	3350
	3425	3600	3650	3950	4100	4300	4650	4750	4900	
75.0		4650	4825	5200	6500	7200	7700	8300	8600	9200
	9500	9500	9200	8600	8300	7700	7200	6500	5200	4825
	4650	4475	4200	4100	4000	3850	3750	3700	3650	3650
	3700	3750	3850	4000	4100	4200	4475	4650	4825	
85.0		4950	4950	5150	5500	6000	6300	6600	7000	7200
	7300	7300	7200	7000	6600	6300	6000	5500	5150	4950
	4900	4750	4650	4525	4450	4400	4350	4300	4270	4270
	4300	4350	4400	4450	4525	4650	4750	4900	4950	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE [illegible] NO. 38

HORZ. ANGLES (V 38 [illegible] 7)										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
90.0		5100	5100	5100	5100	5100	5100	5100	5100	5100
	5100	5100	5100	5100	5100	5100	5100	5100	[illegible]	5100
	5100	5100	5100	5100	5100	5100	5100	5100	5100	5100
	5100	5100	5100	5100	5100	5100	5100	5100	5100	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 37

HORZ. ANGLES (V 58 -4)

		-2.5	2.5	5.0	7.5	12.5	15.0	17.5	25.0	27.5
	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0
	135.0	145.0	152.5	155.0	162.5	165.0	167.5	172.5	175.0	177.5
	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0	215.0	225.0
	235.0	245.0	255.0	265.0	275.0	285.0	295.0	305.0	315.0	325.0
	335.0	337.5	342.5	345.0	347.5	352.5	355.0	357.5	362.5	
VERT.										
-35.0		58	58	58	58	58	58	58	58	58
	58	58	58	58	58	58	58	58	58	58
	58	58	58	58	58	58	58	58	58	58
	58	58	58	58	58	58	58	58	58	58
	58	58	58	58	58	58	58	58	58	58
	58	58	58	58	58	58	58	58	58	
-25.0		186	226	117	[illegible]	[illegible]	88	88	88	88
	88	58	58	58	58	58	58	58	58	58
	58	88	88	88	88	88	[illegible]	[illegible]	117	226
	186	146	117	58	29	36	51	58	58	58
	58	58	58	58	58	58	58	58	58	58
	58	51	36	29	58	117	146	186	226	
-15.0		358	394	466	452	423	408	364	321	306
	291	291	204	262	262	204	204	262	262	204
	291	291	306	321	364	408	423	452	466	394
	358	321	285	212	175	146	87	58	58	58
	58	58	58	58	58	58	58	58	58	58
	58	87	146	175	212	285	321	358	394	
-5.0		514	562	610	618	633	640	625	610	568
	525	580	495	495	437	408	[illegible]	437	495	495
	580	525	568	610	625	640	633	518	619	562
	514	466	437	379	350	328	262	233	175	146
	58	58	58	58	58	58	58	58	146	175
	233	262	328	350	379	437	466	514	562	
0.0		610	730	788	845	930	975	1020	1078	1105
	1131	1046	611	577	472	455	455	472	577	611
	1046	1131	1105	1078	1020	975	930	845	788	730
	610	583	555	495	452	408	321	321	263	263
	233	175	146	117	117	146	175	233	263	263
	321	321	408	452	495	555	583	610	730	
2.5		700	875	990	1105	1253	1353	1455	1515	1630
	1737	1512	727	659	607	602	602	607	659	727
	1512	1737	1630	1615	1455	1353	1250	1105	990	875
	700	640	580	495	466	437	408	364	306	321
	321	233	169	146	146	169	233	321	321	306
	364	408	437	466	495	580	640	700	875	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMI[illegible] CODE: [illegible] TABLE NO. 37

HORZ. ANGLES (V 58 24)										
		-2.5	2.5	5.0	7.5	12.5	15.0	17.5	25.0	27.5
	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0
	135.0	145.0	152.5	155.0	162.5	165.0	167.5	172.5	175.0	177.5
	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0	215.0	225.0
	235.0	245.0	255.0	265.0	275.0	285.0	295.0	305.0	315.0	325.0
	335.0	337.5	342.5	345.0	347.5	352.5	355.0	357.5	362.5	
VERT.										
5.0		815	1135	1340	1515	1620	2165	2270	2765	2795
	2040	1745	785	700	525	525	525	525	700	785
	1746	2040	2795	2765	2270	2165	1920	1515	1340	1135
	815	730	700	495	525	465	379	408	350	379
	408	291	233	175	175	233	291	408	379	350
	408	379	466	525	495	700	730	815	1135	
7.5		2620	785	990	1195	1650	1950	2240	3418	3465
	5130	2709	1120	925	744	714	714	744	925	1120
	2709	5130	3465	3418	2240	1950	1650	1195	990	785
	2620	2445	2270	1720	1545	1370	465	533	451	473
	474	363	306	276	275	306	363	474	473	451
	533	466	1370	1545	1720	2270	2445	2620	785	
10.0		1575	2535	3160	3735	5200	5925	6650	8350	8700
	8220	3673	1455	1150	963	963	963	963	1150	1455
	3673	8220	8700	8350	6650	5925	5200	3735	3160	2535
	1575	1328	1080	755	668	582	555	557	553	567
	539	436	379	378	378	378	436	539	567	553
	657	555	580	668	755	1080	1328	1575	2535	
12.5		2765	4395	5449	6500	9100	10400	11700	13850	13850
	11310	4636	1790	1375	1181	1041	1041	1181	1375	1790
	4636	11310	13850	13850	11700	10400	9100	6500	5449	4395
	2765	2285	1805	1080	918	755	730	781	654	661
	605	508	452	479	479	452	503	505	661	654
	781	730	755	918	1080	1805	2285	2765	4395	
15.0		4895	7750	9400	11550	15800	17700	20050	21400	21050
	14400	5600	2125	1600	1400	1250	1250	1400	1600	2125
	5600	14400	21050	21400	20050	17700	15800	11550	9400	7750
	4895	3755	2885	1720	1400	1195	905	905	755	755
	670	580	525	580	580	525	580	670	755	755
	905	905	1195	1400	1720	2885	3755	4895	7750	
17.5		8100	13000	15875	18750	25400	27325	29250	27700	25850
	16342	6513	3131	2234	1865	1555	1555	1555	2234	3131
	6513	16342	25850	27700	29250	27325	25400	18750	15875	13000
	8100	4525	4950	2765	2213	1660	1225	1115	894	836
	786	725	736	681	681	735	726	736	836	894
	1115	1225	1660	2213	2765	4450	6525	8100	13000	

B80

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 37

HORZ. ANGLES (V 58 34)

		-2.5	2.5	5.0	7.5	12.5	15.0	17.5	25.0	27.5
	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0
	135.0	145.0	152.5	155.0	162.5	165.0	167.5	172.5	175.0	177.5
	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0	215.0	225.0
	235.0	245.0	255.0	265.0	275.0	285.0	295.0	305.0	315.0	325.0
	335.0	337.5	342.5	345.0	347.5	352.5	355.0	357.5	362.5	
VERT.										
20.0		11200	17850	21950	26050	33500	35500	37500	32925	29950
	17855	7425	4138	2869	2331	1835	1835	2331	2869	4138
	7425	17855	29950	32925	37500	35500	33500	26050	21950	17850
	11200	8725	6250	3380	2665	1950	1400	1325	1033	918
	903	873	948	793	793	948	873	903	918	1033
	1325	1400	1950	2665	3380	6250	8725	11200	17850	
22.5		13550	21550	25750	29550	35550	36425	37300	31275	28000
	17323	8338	5444	3591	2745	2113	2113	2745	3591	5444
	8338	17323	28000	31275	37300	36425	35550	29550	25750	21550
	13550	10725	7900	4195	3305	2415	1690	1534	1171	999
	1019	1019	1159	884	884	1159	1019	1019	999	1171
	1534	1690	2415	3305	4195	7900	10725	13550	21550	
25.0		13350	20950	24800	28750	34550	35850	35600	29150	25500
	16800	9250	6150	4135	3260	2390	2390	3260	4135	6150
	9250	16800	25500	29150	35600	35850	34550	28750	24800	20950
	13350	10500	7850	4395	3405	2680	1920	1745	1310	1080
	1135	1165	1370	985	985	1370	1165	1135	1080	1310
	1745	1920	2680	3405	4395	7850	10500	13350	20950	
27.5		12600	18500	21500	24500	25400	25675	28950	24200	23300
	18088	10413	6575	4539	3870	3130	3130	3870	4539	6575
	10413	18088	23300	24200	28950	25675	25400	24500	21500	18500
	12600	10325	8050	5000	4160	3320	2445	2263	1649	1589
	1493	1464	1625	1329	1329	1625	1464	1493	1589	1649
	2263	2445	3320	4160	5000	8050	10325	12600	18500	
30.0		11100	15950	18575	21200	25025	25700	26350	23700	22500
	19375	11575	7000	4943	4480	3870	3870	4480	4943	7000
	11575	19375	22500	23700	26350	25700	25025	21200	18575	15950
	11100	9275	7450	5200	4625	4050	3405	2780	2388	2048
	1880	1763	1880	1673	1673	1880	1763	1880	2048	2388
	2780	3405	4050	4625	5200	7450	9275	11100	15950	
35.0		10238	13213	14700	16425	19475	21500	22363	24650	23300
	21950	13900	7850	5750	5700	5450	5450	5700	5750	7850
	13900	21950	23300	24650	22363	21500	19475	16425	14700	13213
	10238	8750	7813	5934	5000	4704	4111	3815	3465	3115
	2565	2360	2390	2360	2360	2390	2360	2565	3115	3465
	3815	4111	4704	5000	5934	7813	8750	10238	13213	

881

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V43[illegible] TABLE NO. 37

HORZ. ANGLES (V 58 94)										
		-2.5	2.5	5.0	7.5	12.5	15.0	17.5	25.0	27.5
	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0
	135.0	145.0	152.5	155.0	162.5	165.0	167.5	172.5	175.0	177.5
	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0	215.0	225.0
	235.0	245.0	255.0	265.0	275.0	285.0	295.0	305.0	315.0	325.0
	335.0	337.5	342.5	345.0	347.5	352.5	355.0	357.5	362.5	
VERT.										
45.0		9138	11713	13000	14550	17450	19600	20013	21250	19350
	17450	13150	9000	7000	5550	4775	4775	5450	7000	9000
	13150	17450	19350	21250	20013	19600	17450	14550	13000	11713
	9138	7850	7125	5675	4950	4674	4121	3545	3495	2555
	2505	2475	2445	2415	2415	2445	2475	2505	2555	2495
	3845	4121	4674	4950	5675	7125	7850	9138	11713	
55.0		5461	4984	4745	5234	9211	10700	11338	13250	13450
	13650	12700	11000	10000	8550	7250	7250	8550	10000	11000
	12700	13650	13450	13250	11338	10700	9211	5234	4745	4984
	5461	5700	5273	4419	3990	3837	3379	3175	2745	2650
	2590	2620	3260	2765	2765	3260	2620	2590	2650	2795
	3175	3379	3837	3990	4418	5273	5700	5461	4984	
65.0		4648	5383	5750	6225	7175	7650	8075	9350	9950
	10550	11050	11200	11200	10300	9300	9300	10300	11200	11200
	11050	10550	9950	9350	8075	7650	7175	6225	5750	5383
	4648	4280	3989	3406	3115	3006	2680	2535	2300	2240
	2240	2415	2505	2475	2475	2505	2415	2240	2240	2300
	2535	2680	3006	3115	3406	3989	4280	4648	5383	
75.0		4104	4032	4970	5165	5555	5750	6025	6350	7425
	8000	8950	9600	9750	10100	10550	10550	10100	9750	9600
	8950	8000	7425	6350	6025	5750	5555	5165	4970	4032
	4104	3815	3611	3204	3000	3001	3002	2505	2240	2045
	2010	2040	2040	2125	2125	2040	2040	2010	2045	2240
	2505	3002	3001	3000	3204	3611	3815	4104	4032	
85.0		4735	4709	5050	5125	5275	5350	5438	5700	5825
	5950	6400	6700	7000	7250	7450	7450	7250	7000	6700
	6400	5950	5825	5700	5438	5350	5275	5125	5050	4709
	4735	4630	4535	4345	4250	4250	4251	3900	3640	3465
	3260	3235	3205	3175	3175	3205	3235	3260	3465	3640
	3900	4251	4250	4250	4345	4535	4630	4735	4709	
90.0		5116	5116	5116	5116	5116	5116	5116	5116	5116
	5116	5116	5116	5116	5116	5116	5116	5116	5116	5116
	5116	5116	5116	5116	5116	5116	5116	5116	5116	5116
	5116	5116	5116	5116	5116	5116	5116	5116	5116	5116
	5116	5116	5116	5116	5116	5116	5116	5116	5116	5116
	5116	5116	5116	5116	5116	5116	5116	5116	5116	

802

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V[illegible] [illegible] NO. [illegible]

HORZ. ANGLES (V [illegible] 5H [illegible] 4)

VERT.										
HORZ.		-2.5	2.5	5.0	7.5	12.5	15.	17.5	25.0	27.5
	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0
	135.0	145.0	152.5	155.0	162.5	165.0	167.5	172.5	175.0	177.5
	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0	215.0	225.0
	235.0	245.0	255.0	265.0	275.0	285.0	295.0	305.0	315.0	325.0
	335.0	337.5	342.5	345.0	347.5	352.5	355.0	357.5	362.5	
-35.0		0	0	0	0	0	0	0	0	0
	0	7	7	22	52	37	37	52	22	7
	7	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
-25.0		61	64	66	[illegible]	77	81	78	74	[illegible]
	56	88	110	118	133	133	133	133	118	110
	88	56	65	74	78	81	77	[illegible]	56	54
	61	59	61	64	66	57	35	29	29	7
	7	7	7	7	7	7	7	7	7	29
	29	48	57	66	64	61	[illegible]	61	64	
-15.0		102	113	119	116	112	110	203	193	114
	125	155	176	192	198	206	205	198	192	176
	155	125	114	103	203	110	112	116	115	113
	102	96	96	96	96	94	[illegible]	88	74	96
	66	15	0	0	0	0	15	65	46	74
	88	90	94	96	96	95	[illegible]	102	113	
-5.0		176	187	192	203	224	230	323	235	130
	258	272	266	[illegible]	240	[illegible]	[illegible]	240	[illegible]	[illegible]
	272	258	130	235	328	235	224	213	192	137
	176	170	163	148	140	134	135	133	133	206
	206	118	66	59	59	65	118	205	206	133
	133	135	138	142	144	163	170	176	187	
0.0		294	302	313	323	352	355	390	600	390
	527	453	388	353	317	320	320	317	353	388
	453	527	390	600	390	386	352	323	313	302
	294	280	266	198	191	154	144	163	155	225
	386	199	132	107	107	132	144	386	225	155
	163	184	184	191	195	266	[illegible]	244	302	
2.5		360	616	566	515	552	576	[illegible]	743	574
	661	544	448	346	335	340	[illegible]	336	[illegible]	445
	544	661	574	763	[illegible]	576	552	515	566	616
	360	313	266	213	266	193	134	177	182	234
	476	240	165	131	131	165	240	476	234	182
	177	184	198	206	213	266	313	360	616	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMI[illegible] CODE: VI[illegible] TABLE NO. 3[illegible]

HORZ. ANGLES (V 53 3[illegible])

		-2.5	2.5	5.0	7.5	12.5	15.0	17.5	25.0	27.5
	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0
	135.0	145.0	152.5	155.0	162.5	165.0	167.5	172.5	175.0	177.5
	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0	215.0	225.0
	235.0	245.0	255.0	265.0	275.0	285.0	295.0	305.0	315.0	325.0
	335.0	337.5	342.5	345.0	347.5	352.5	355.0	357.5	362.5	
VERT.										
5.0		442	597	722	773	853	634	987	965	898
	795	634	509	419	354	360	350	354	419	509
	634	795	898	965	987	634	853	773	722	597
	442	398	331	250	235	221	198	192	198	243
	566	280	198	155	155	198	243	566	243	198
	192	199	221	235	250	331	398	442	597	
7.5		611	877	1087	1295	1775	2335	2895	1320	1664
	1132	831	627	513	424	405	405	424	513	627
	831	1132	1664	1320	2895	2336	1775	1295	1087	877
	611	519	427	323	287	250	250	281	233	258
	519	326	227	190	190	227	326	519	258	233
	281	250	250	287	323	427	519	611	877	
10.0		965	1525	2091	2656	3420	4144	4368	2675	3072
	1639	1028	744	607	494	443	443	494	607	744
	1028	1638	3072	2675	4368	4144	3420	2656	2091	1525
	965	800	634	442	387	331	317	369	269	273
	471	372	255	225	225	255	372	471	273	269
	369	317	331	387	442	634	800	965	1525	
12.5		1531	2688	3840	4992	6448	6712	5975	3530	3136
	1807	1224	862	701	564	494	494	564	701	862
	1224	1807	3136	3530	5975	6712	6448	4992	3840	2688
	1531	1076	920	611	455	299	472	459	304	287
	424	418	284	259	259	284	418	424	287	304
	459	472	299	455	611	920	1076	1531	2688	
15.0		2480	4480	6176	8080	9792	10272	8896	4384	3376
	2144	1421	979	795	634	538	538	634	795	979
	1421	2144	3376	4384	8896	10272	9792	8080	6176	4480
	2480	1840	1451	987	951	736	611	546	334	302
	376	464	312	294	294	312	464	376	302	334
	546	611	736	861	987	1451	1840	2480	4480	
17.5		3360	5616	6752	7836	8304	7520	5736	4880	4128
	2688	1734	1170	904	717	623	623	717	904	1170
	1734	2688	4128	4880	5736	7520	8304	7836	6752	5616
	3360	2496	2032	1362	1167	971	722	680	438	344
	385	459	359	362	362	359	459	385	343	438
	680	722	971	1167	1362	2032	2496	3360	5616	884

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V1[illegible] TABLE NO. [illegible]

HORZ. ANGLES (V 58 24)										
		-2.5	2.5	5.0	7.5	12.5	15.0	17.5	25.0	27.5
	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0
	135.0	145.0	152.5	155.0	162.5	165.0	167.5	172.5	175.0	177.5
	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0	215.0	225.0
	235.0	245.0	255.0	265.0	275.0	285.0	295.0	305.0	315.0	325.0
	335.0	337.5	342.5	345.0	347.5	352.5	355.0	357.5	362.5	
VERT.										
20.0		3872	4992	5432	5672	6272	6416	6560	5376	4752
	3232	2047	1362	1013	800	705	705	800	1013	1362
	2047	3232	4752	5376	6560	6416	6272	5872	5432	4992
	3872	3320	2768	1920	1615	1310	957	814	536	394
	395	453	407	430	430	407	453	395	394	536
	814	957	1310	1615	1920	2768	3320	3872	4992	
22.5		3392	4208	4720	5232	6288	6564	6849	5872	5456
	3776	2359	1553	1121	842	742	742	842	1121	1553
	2359	3776	5456	5872	6849	6564	6288	5232	4720	4208
	3392	2984	2576	1904	1663	1421	1120	948	637	449
	404	448	454	498	498	454	448	404	446	637
	948	1120	1421	1663	1904	2576	2984	3392	4208	
25.0		3200	4048	4784	5216	6000	6112	6384	6368	5792
	4320	2672	1744	1230	965	877	877	965	1230	1744
	2672	4320	5792	6368	6384	6112	6000	5216	4784	4048
	3200	2896	2496	2148	1808	1494	1185	1082	736	495
	413	442	501	566	566	501	442	413	496	736
	1082	1185	1494	1808	2148	2496	2896	3200	4048	
27.5		4816	2864	3128	3392	[illegible]	3664	3920	6116	5952
	4464	2960	2196	1419	1119	751	751	1119	1419	2196
	2960	4464	5952	6116	3920	3664	[illegible]	3392	3128	2864
	4816	4472	4128	3104	2776	2448	1362	1243	769	541
	474	501	578	664	664	578	501	474	541	769
	1243	1362	2448	2776	3104	4128	4472	4816	2864	
30.0		2672	3616	3936	4256	4768	5040	5312	5864	5808
	4608	3098	2448	1607	1274	826	826	1274	1607	2448
	3098	4608	5808	5864	5312	5040	4768	4256	3936	3616
	2672	2544	2416	1952	1776	1600	1370	1257	[illegible]	597
	535	560	656	762	762	656	560	535	597	[illegible]
	1257	1370	1600	1776	1952	2416	2544	2672	3616	
35.0		2636	3044	3248	3492	3960	4224	5005	5360	5128
	4896	3824	3152	1984	1582	874	874	1582	1984	3152
	3824	4896	5128	5360	5005	4224	3960	3492	3248	3044
	2626	2432	2220	1795	1582	1457	1207	1082	[illegible]	707
	656	677	810	957	957	810	677	656	707	469
	1082	1207	1457	1582	1795	2220	2432	2626	3044	

885

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 33

HORZ. ANGLES (V 5H -4)

		-2.5	2.5	5.0	7.5	12.5	15.0	17.5	25.0	27.5
	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0
	135.0	145.0	152.5	155.0	162.5	165.0	167.5	172.5	175.0	177.5
	182.5	185.0	187.5	192.5	195.0	197.5	202.5	205.0	215.0	225.0
	235.0	245.0	255.0	265.0	275.0	285.0	295.0	305.0	315.0	325.0
	335.0	337.5	342.5	345.0	347.5	352.5	355.0	357.5	362.5	
VERT.										
45.0		2528	2880	3056	3140	3426	3552	4392	4528	4712
	4896	4640	4016	3200	2864	2736	2736	2864	3200	4016
	4640	4896	4712	4528	4392	3552	3426	3140	3056	2880
	2528	2352	2188	1860	1696	1574	1330	1208	965	854
	810	803	840	906	906	840	803	810	854	965
	1208	1330	1574	1696	1860	2188	2352	2528	2880	
55.0		2552	2696	2768	2790	2804	2816	3774	3488	3392
	3696	3984	3728	3600	3344	3168	3168	3344	3600	3728
	3984	3696	3392	3988	3774	2816	2804	2790	2768	2696
	2552	2480	2292	1916	1728	1596	1332	1200	1008	920
	861	832	840	846	846	840	832	861	920	1008
	1200	1332	1596	1728	1916	2292	2480	2552	2696	
65.0		1988	2092	2144	2154	2224	2224	3165	2368	2448
	2529	2656	2688	2640	2576	2400	2400	2576	2640	2688
	2656	2528	2448	2368	3165	2224	2224	2154	2144	2092
	1988	1936	1850	1677	1590	1511	1353	1274	1120	1024
	957	942	928	898	898	928	942	957	1024	1120
	1274	1353	1511	1590	1677	1850	1936	1988	2092	
75.0		1688	1768	1808	1824	1555	1572	2552	1920	1936
	1952	2000	2096	2080	2048	2032	2136	2048	2080	2096
	2000	1952	1936	1920	2552	1572	1555	1824	1808	1768
	1688	1648	1619	1560	1531	1504	1449	1421	1347	1296
	1251	1186	1134	1098	1098	1134	1186	1251	1296	1347
	1421	1449	1504	1531	1560	1619	1648	1688	1768	
85.0		1660	1684	1696	1700	1708	1712	1939	1744	1752
	1760	1760	1760	1760	1760	1744	1744	1760	1760	1760
	1760	1760	1752	1744	1939	1712	1708	1700	1696	1684
	1660	1648	1632	1605	1590	1579	1557	1546	1525	1472
	1458	1435	1414	1384	1394	1414	1435	1458	1472	1519
	1546	1557	1579	1590	1605	1632	1648	1660	1684	
90.0		1632	1632	1632	1632	1632	1632	1632	1632	1632
	1632	1632	1632	1632	1632	1632	1632	1632	1632	1632
	1632	1632	1632	1632	1632	1632	1632	1632	1632	1632
	1632	1632	1632	1632	1632	1632	1632	1632	1632	1632
	1632	1632	1632	1632	1632	1632	1632	1632	1632	1632
	1632	1632	1632	1632	1632	1632	1632	1632	1632	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. [illegible]

HORZ. ANGLES (H 12 14)

VERT.	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0
-32.5	0	0	0	0	140	0	0	140	0	0	0	0
-27.5	0	0	160	2320	5040	1120	1120	5040	2320	160	0	0
-22.5	0	465	4570	5440	5650	5140	5140	5650	5440	4570	465	0
-17.5	0	2230	6020	6340	6670	6000	6000	6670	6340	6020	2230	0
-12.5	340	5945	7780	8410	8370	7550	7550	8370	8410	7780	5945	340
-7.5	2290	9290	13800	15450	15790	14110	14110	15790	15450	13800	9290	2290
-2.5	3660	20530	33290	41840	44600	46750	46750	44600	41840	33290	20530	3660
2.5	3780	22945	36980	45980	51870	49790	49790	51870	45980	36980	22945	3780
7.5	1950	9570	14200	16240	16600	15230	15230	16600	16240	14200	9570	1950
12.5	230	6220	8180	8740	8590	7450	7450	8590	8740	8180	6220	230
17.5	0	2510	6020	6820	6940	6200	6200	6940	6820	6020	2510	0
22.5	0	460	4490	5660	5320	5340	5340	5320	5660	4490	460	0
27.5	0	0	240	2470	5340	2040	2040	5340	2470	240	0	0
32.5	0	0	0	0	100	0	0	100	0	0	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE [illegible]

HORZ. ANGLES (H 14 14)

VERT.	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0
-19.5	1030	2290	3560	4150	4590	5330	6160	6160	5330	4590	4150	3560	2290	1030
-16.5	1090	2480	3720	4410	5080	6010	7150	7150	6010	5080	4410	3720	2480	1090
-13.5	1130	2675	3875	4820	5560	6690	7420	7420	6690	5560	4820	3875	2675	1130
-10.5	1180	3060	4960	6020	7370	8820	9570	9570	8820	7370	6020	4960	3060	1180
-7.5	1220	4200	8060	10970	12820	14750	15500	15500	14750	12820	10970	8060	4200	1220
-4.5	1260	8790	20450	29290	34090	40600	38500	38500	40600	34090	29290	20450	8790	1260
-1.5	1300	16430	41990	59920	68550	81220	76440	76440	81220	68550	59920	41990	16430	1300
1.5	1320	17200	42300	62060	72540	85200	79080	79080	85200	72540	62060	42300	17200	1320
4.5	1280	9360	23550	33970	40140	44440	46300	46300	44440	40140	33970	23550	9360	1280
7.5	1240	4590	10540	13780	16560	20030	20130	20130	20030	16560	13780	10540	4590	1240
10.5	1190	3060	5270	6960	8700	10100	10590	10590	10100	8700	6960	5270	3060	1190
13.5	1140	2870	4030	4950	6170	7250	8250	8250	7250	6170	4950	4030	2870	1140
16.5	1080	2470	3560	4280	5075	5900	7040	7040	5900	5075	4280	3560	2470	1080
19.5	1020	2280	3510	4010	4470	5220	5050	5050	5220	4470	4010	3510	2280	1020

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] NO. 41

HORZ. ANGLES (H 18 18)

VERT.										
		22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0
	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0	
-42.5		99	594	1551	2541	3366	3663	4092	3861	4191
	4191	3861	4092	3663	3366	2541	1551	594	99	
-37.5		165	858	1782	2838	3432	3729	4191	4059	4620
	4620	4059	4191	3729	3432	2838	1782	858	165	
-32.5		231	1023	2079	3069	3630	3894	4356	4389	5049
	5049	4389	4356	3894	3630	3069	2079	1023	231	
-27.5		330	1353	2508	3531	3861	4092	4653	4752	5544
	5544	4752	4653	4092	3861	3531	2508	1353	330	
-22.5		495	1584	2904	4158	4389	4587	5148	5346	6204
	6204	5346	5148	4587	4389	4158	2904	1584	495	
-17.5		495	1980	3663	5346	5808	5973	6600	6765	7986
	7986	6765	6600	5973	5808	5346	3663	1980	495	
-12.5		528	2277	5115	8052	9537	9966	10923	10791	12309
	12309	10791	10923	9966	9537	8052	5115	2277	528	
-7.5		528	3102	9438	16269	21252	24453	26895	25410	27060
	27060	25410	26895	24453	21252	16269	9438	3102	528	
-2.5		528	4455	16533	30822	41712	50292	57024	52140	53856
	53856	52140	57024	50292	41712	30822	16533	4455	528	
2.5		561	4224	15840	29898	40359	48444	55242	51315	52734
	52734	51315	55242	48444	40359	29898	15840	4224	561	
7.5		561	2607	7986	14223	18579	21450	23958	23001	24651
	24651	23001	23958	21450	18579	14223	7986	2607	561	
12.5		561	2046	4554	7293	8745	9537	10659	10560	12111
	12111	10560	10659	9537	8745	7293	4554	2046	561	
17.5		528	1749	3366	5049	5643	5940	6600	6798	8085
	8085	6798	6600	5940	5643	5049	3366	1749	528	
22.5		462	1584	2871	4125	4389	4620	5181	5412	6534
	6534	5412	5181	4620	4389	4125	2871	1584	462	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMI[illegible] 41

HORZ. ANGLES (H 18 18)

VERT.									
	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0
	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
27.5	396	1320	2508	3531	3951	4092	4653	4752	5610
	5610	4752	4653	4092	3951	3531	2508	1320	396
32.5	297	1089	2145	3267	3729	4026	4488	4455	5148
	5148	4455	4488	4026	3729	3267	2145	1089	297
37.5	132	858	1782	2838	3498	3795	4191	3960	4620
	4620	3960	4191	3795	3498	2838	1782	858	132
42.5	132	561	1551	2511	3365	3729	4125	3894	4026
	4026	3894	4125	3729	3365	2511	1551	561	132

890

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible]

HORZ. ANGLES (H 18 18)

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
-68.0	0	0	66	99	165	231	264	264	330	330	264	264	231	165	99	66	0	0
-60.0	66	56	99	165	231	264	330	330	396	396	330	330	264	231	165	99	66	66
-52.0	66	99	165	231	264	330	396	396	429	429	396	396	330	264	231	165	99	66
-44.0	132	528	1353	2376	3300	3630	4191	3927	4125	4125	3927	4191	3630	3300	2376	1353	528	132
-36.0	231	924	2145	3300	4356	4653	5313	5049	5346	5346	5049	5313	4653	4356	3300	2145	924	231
-28.0	396	1320	2871	4587	5775	6270	7095	6798	7293	7293	6798	7095	6270	5775	4587	2871	1320	396
-20.0	495	1650	3894	6204	7920	8910	10032	9933	10362	10362	9933	10032	8910	7920	6204	3894	1650	495
-12.0	462	1914	4818	8118	11022	13002	14817	14751	15411	15411	14751	14817	13002	11022	8118	4818	1914	462
-4.0	561	2442	6336	11154	15312	18183	20955	20856	21714	21714	20856	20955	18183	15312	11154	6335	2442	561
4.0	495	2310	6336	10890	15114	18117	20922	21021	22044	22044	21021	20922	18117	15114	10890	6336	2310	495
12.0	495	2079	5247	8580	11451	13398	15312	15312	15906	15906	15312	15312	13398	11451	8580	5247	2079	495
20.0	429	1650	3927	6336	8217	9297	10428	10296	10659	10659	10296	10428	9297	8217	6336	3927	1650	429
28.0	363	1353	2970	4719	5940	6501	7458	7161	7557	7557	7161	7458	6501	5940	4719	2970	1353	363
36.0	231	990	2079	3432	4455	4785	5511	5181	5511	5511	5181	5511	4785	4455	3432	2079	990	231

CANDLEPOWER TABLE [illegible]

CANDLEPOWER TABLE - [illegible] TABLE NO. 42

HORZ. ANGLES (H [illegible])

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
44.0	165	528	1410	2442	3465	3644	429[illegible]	3933	3927	3927	3943	429[illegible]	3646	3465	2442	1410	528	165
52.0	66	99	165	231	264	33[illegible]	396	396	429	429	396	396	330	264	231	165	99	66
60.0	66	66	99	165	231	264	330	330	396	396	330	330	264	231	165	99	66	66
68.0	0	0	66	99	165	231	264	264	330	330	264	264	231	165	99	66	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] TABLE NO. 43

HORZ. ANGLES (H 1- 18)

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
-17.0	561	1914	3828	5214	5742	5214	6095	6096	6831	6831	6096	6095	5214	5742	5214	3828	1914	561
-15.0	561	2178	4389	6303	6567	6303	6567	6831	7656	7656	6831	6567	6303	6567	6303	4389	2178	561
-13.0	561	2178	4653	7128	7920	7128	7392	7392	8745	8745	7392	7392	7128	7920	7128	4653	2178	561
-11.0	561	2475	5742	8745	9867	8745	8745	9042	10131	10131	9042	8745	8745	9867	8745	5742	2475	561
-9.0	561	2739	7392	11484	13134	12045	11484	11484	12309	12309	11484	11484	12045	13134	11484	7392	2739	561
-7.0	561	3564	9867	16137	19701	18612	17226	16137	16698	16698	16137	17226	18612	19701	16137	9867	3564	561
-5.0	561	3564	12309	23265	32274	35927	34749	30657	29007	29007	30657	34749	35927	32274	23265	12309	3564	561
-3.0	561	3564	13959	29007	44319	59014	65109	61578	60489	60489	61578	65109	59014	44319	29007	13959	3564	561
-1.0	561	3828	14457	30360	49533	68573	86196	91674	94413	94413	91674	86196	68573	49533	30360	14457	3828	561
1.0	561	3564	12870	27621	44616	59367	76055	78804	84282	84282	78804	76055	59367	44616	27621	12870	3564	561
3.0	561	3003	11220	22704	34221	42405	48444	45144	45144	45144	45144	48444	42405	34221	22704	11220	3003	561
5.0	561	3300	9042	17226	23001	25179	25443	23793	24354	24354	23793	25443	25179	23001	17226	9042	3300	561
7.0	561	2739	7392	13134	16434	16548	15648	15873	16698	16698	15873	15648	16548	16434	13134	7392	2739	561
9.0	561	2739	6567	11345	12573	12309	12045	11484	12523	12523	11484	12045	12309	12573	11345	6567	2739	561

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LU[illegible] TABLE NO. 43

HORZ. ANGLES (H [illegible])

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
11.0	561	2475	5476	12345	9467	9306	9306	9306	10395	10395	9306	9306	9306	9467	12345	5476	2475	561
13.0	561	1914	4553	7128	7420	7392	7556	7392	6745	6745	7392	7656	7392	7420	7128	4553	1914	561
15.0	561	1914	4389	6006	6567	6303	6831	6831	7920	7920	6831	6831	6303	6567	6006	4389	1914	561
17.0	561	1914	3828	5478	5478	5214	6006	6006	7128	7128	6006	6006	5214	5478	5478	3828	1914	561

CANDLEPOWER ... TABLE ... TABLE NO. 44

HORZ. ANGLES (H 15 14)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
-76.0	73	173	241	315	395	733	1131	1202	1202	1131	733	395	315	241	173	73
-68.0	156	293	829	4214	4821	5325	5615	5749	5749	5615	5325	4821	4214	829	293	156
-60.0	210	510	4193	5243	6015	6630	7050	7268	7268	7050	6630	6015	5243	4193	510	210
-52.0	278	1413	4793	5985	6953	7815	8625	8940	8940	8625	7815	6953	5985	4793	1413	278
-44.0	540	2100	4875	6105	7655	9555	12160	15075	15075	12160	9555	7655	6105	4875	2100	540
-36.0	960	2310	4530	6150	11235	17380	19395	21150	21150	19395	17380	11235	6150	4530	2310	960
-28.0	1155	2065	4440	5660	11355	16445	22875	27555	27555	22875	16445	11355	5660	4440	2065	1155
-20.0	990	1635	4110	5675	11505	17525	22840	25850	25850	22840	17525	11505	5675	4110	1635	990
-12.0	550	1315	3915	5435	14115	20700	25485	27500	27500	25485	20700	14115	5435	3915	1315	550
-4.0	458	1035	3713	5945	7478	8925	12023	12450	12450	12023	8925	7478	5945	3713	1035	458
4.0	231	533	999	1344	1673	1991	2576	2963	2963	2576	1991	1673	1344	999	533	231
12.0	183	333	587	968	1056	1067	1755	2306	2306	1755	1067	1056	968	587	333	183
20.0	161	199	265	371	451	634	1939	2723	2723	1939	634	451	371	265	199	161
28.0	137	154	199	225	247	275	444	577	577	444	275	247	225	199	154	137

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. [illegible]

HORZ. ANGLES (H 1- 15)

VERT.	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
-75.0	0	0	0	287	234	602	1067	1020	987	987	1020	1067	602	234	287	0	0	0
-65.0	0	0	388	574	935	1807	1993	1871	1809	1809	1871	1993	1807	935	574	388	0	0
-55.0	0	0	775	1149	2337	3213	3089	2891	2796	2796	2891	3089	3213	2337	1149	775	0	0
-45.0	0	654	1663	3736	6542	7229	6522	5752	5263	5263	5752	6522	7229	6542	3736	1663	654	0
-35.0	0	656	1550	4045	11443	11446	11776	8503	7730	7730	8503	11776	11446	11443	4045	1550	656	0
-25.0	0	658	3483	10345	15884	16265	14674	12585	11184	11184	12585	14674	16265	15884	10345	3483	658	0
-15.0	0	654	5426	12644	19159	20884	21014	20748	18914	18914	20748	21014	20884	19159	12644	5425	654	0
-5.0	0	1316	5514	13215	19850	22289	25151	24830	22662	22662	24830	25151	22289	19850	13215	5514	1316	0
5.0	0	1316	5614	12644	14692	19551	20833	19557	17599	17599	19557	20833	19551	14692	12644	5614	1316	0
15.0	0	1316	3476	10345	15421	14059	13406	11345	10197	10197	11345	13406	14059	15421	10345	3476	1316	0
25.0	0	653	2326	8045	10748	11044	9420	7943	7237	7237	7943	9420	11044	10748	8045	2326	653	0
35.0	0	653	1153	4023	6775	7631	6521	5782	5263	5263	5782	6521	7631	6775	4023	1153	653	0
45.0	0	654	775	1724	3271	4415	4157	3912	3618	3613	3912	4157	4415	3271	1724	775	653	0
55.0	0	0	348	475	438	2410	2595	2551	2467	2467	2551	2595	2410	438	475	348	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] TABLE NO. 45

HORZ. ANGLES (H [illegible])

VERT.	5.0 / 95.0	15.0 / 105.0	25.0 / 115.0	35.0 / 125.0	45.0 / 135.0	55.0 / 145.0	65.0 / 155.0	75.0 / 165.0	85.0 / 175.0
65.0	0	0	368	247	667	[illegible]	[illegible]	1531	1151
	1151	1531	1530	1205	667	247	[illegible]	0	0
75.0	0	0	0	0	234	201	[illegible]	170	[illegible]
	[illegible]	170	181	201	234	0	0	0	0

CANDLEPOWER TABLE [illegible]

CANDLEPOWER TABLE - [illegible]

HORZ. ANGLES (H 1= 1?)

VERT.	47.5	52.5	57.5	62.5	67.5	72.5	77.5	82.5	87.5	92.5	97.5	102.5	107.5	112.5	117.5	122.5	127.5	132.5
-42.5	3296	3462	3050	3034	3357	3724	3656	3709	3690	3690	3709	3652	3729	3357	3034	3050	3462	3246
-37.5	3556	3026	3045	3435	3650	4115	4790	5549	5827	5827	5549	4790	4115	3660	3655	3045	3026	3556
-32.5	3252	3165	3600	4021	5245	6698	9029	11662	12710	12710	11662	9029	6698	5245	4021	3600	3165	3252
-27.5	3376	3817	4373	5474	8670	13415	17040	20323	21439	21439	20323	17040	13415	8670	5474	4373	3817	3376
-22.5	3678	4472	6235	9212	14441	20174	24245	27143	28109	28109	27143	24245	20174	14441	9212	6235	4472	3678
-17.5	4077	5289	9206	13862	19940	25240	28751	32844	35201	35201	32844	28751	25240	19940	13862	9206	5289	4077
-12.5	4323	6150	10167	16827	23232	27954	33443	36996	43095	43095	36996	33443	27954	23232	16827	10167	6150	4323
-7.5	4510	6914	12259	19383	25301	30721	35756	44772	58552	58552	44772	35756	30721	25301	19383	12259	6914	4510
-2.5	4663	7406	13424	20779	26757	33129	34544	54529	104167	104167	54529	34544	33129	26757	20779	13424	7406	4663
2.5	4654	7355	13311	20647	26437	32672	39932	59476	112946	112946	59476	39932	32672	26437	20647	13311	7355	4654
7.5	4503	6921	12389	19680	25550	30939	33732	46927	53688	53688	46927	33732	30939	25550	19680	12389	6921	4503
12.5	4313	6174	10312	17535	24244	28415	32373	33938	36076	36076	33938	32373	28415	24244	17535	10312	6174	4313
17.5	4106	5225	8232	14030	19332	23019	22490	29921	31013	31013	29921	22490	23019	19332	14030	8232	5225	4106
22.5	3743	4533	6413	9295	13404	17152	22251	24299	25165	25165	24299	22251	17152	13404	9295	6413	4533	3743

[illegible]

[illegible] TABLE NO. 45

HORZ. ANGLES (H 1- 18)

VERT.	47.5	52.5	57.5	62.5	67.5	72.5	77.5	82.5	87.5	92.5	97.5	102.5	107.5	112.5	117.5	122.5	127.5	132.5
27.5	3541	4119	4833	5414	5774	[illegible]	[illegible]	[illegible]	19573	19573	[illegible]	16659	[illegible]	5774	5414	[illegible]	4119	3541
32.5	3621	[illegible]	4211	[illegible]	[illegible]	[illegible]	[illegible]	11781	[illegible]	12930	11781	[illegible]	7966	[illegible]	[illegible]	4211	[illegible]	3621
37.5	4067	[illegible]	3743	4154	4617	[illegible]	[illegible]	[illegible]	7483	[illegible]	6901	6152	5335	4617	4154	3743	[illegible]	4067
42.5	3820	4114	3704	3732	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4951	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4114	[illegible]

[illegible] TABLE PRINTOUT

[illegible] TABLE [illegible] NO. 47

HORZ. ANGLES ([illegible])

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
-68.0	0	0	0	94	264	472	652	806	860	860	806	652	472	264	94	0	0	0
-60.0	0	21	240	644	1102	1878	2614	3018	3174	3174	3018	2614	1878	1102	644	240	21	0
-52.0	0	232	921	1744	2654	3722	4040	3409	3199	3199	3409	4040	3722	2654	1744	921	232	[illegible]
-44.0	91	557	1781	3124	3539	2782	3114	3747	4492	4492	3747	3114	2782	3539	3124	1781	557	91
-36.0	244	1152	3022	3445	2711	4140	7237	9413	11433	11433	9413	7237	4140	2711	3445	3022	1152	244
-28.0	455	1907	3918	3144	4493	8491	14600	20245	23314	23314	20245	14600	8491	4493	3144	3918	1907	455
-20.0	654	2512	4132	3616	7235	14751	22051	26755	29192	29192	26755	22051	14751	7235	3616	4132	2512	654
-12.0	779	3011	3677	4364	10249	19236	25502	28913	33190	33190	28913	25502	19236	10249	4364	3677	3011	779
-4.0	869	3198	3441	5040	11752	21743	27266	31634	36417	36417	31634	27266	21743	11752	5040	3441	3198	869
4.0	494	3232	3526	5025	11603	21613	27374	34050	35363	35363	34050	27374	21613	11603	5025	3526	3232	494
12.0	532	3073	3730	4353	10335	19471	26177	28803	29345	29345	28803	26177	19471	10335	4353	3730	3073	532
20.0	706	2583	4248	3679	7933	14493	20415	23096	25506	25506	23096	20415	14493	7933	3679	4248	2583	706
28.0	523	2016	4014	3363	4650	8620	12959	18745	20464	20464	18745	12959	8620	4650	3363	4014	2016	523
36.0	311	1257	3250	4165	3504	4837	7743	10109	11557	11557	10109	7743	4837	3504	4165	3250	1257	311

8100

CANDLEPOWER TABLE PRINTOUT

[illegible] TABLE NO. 47

HORZ. ANGLES

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
44.0	107	501	2071	3635	4215	3613	4090	4424	5533	5533	4424	4090	3613	4215	3635	2071	501	107
52.0	0	356	1021	2091	3316	4105	4427	4089	3957	3957	4089	4427	4105	3316	2091	1021	356	0
60.0	0	17	364	[illegible]	1356	2107	2804	3235	3431	3431	3235	2804	2107	1356	[illegible]	364	17	0
68.0	0	0	0	115	339	576	796	957	1033	1033	957	796	576	339	115	0	0	0

B101

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. [illegible]

HORZ. ANGLES (H 13 10)

VERT.	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0
-15.0	500	1000	2000	3000	4000	4000	4000	4000	4000	3000	2000	1000	500
-12.0	2000	4000	7000	9000	9000	9000	9000	9000	9000	9000	7000	4000	2000
-9.0	3000	6000	10000	12000	13000	13000	13000	13000	13000	12000	10000	6000	3000
-6.0	3500	12000	21000	25000	26000	26000	25000	26000	26000	25000	21000	12000	3500
-3.0	4000	16000	47000	50000	55000	59000	68000	59000	55000	60000	47000	16000	4000
0.0	6000	26000	59000	70000	71000	72000	80000	72000	71000	70000	59000	26000	5000
3.0	6000	22000	40000	52000	57000	59000	60000	59000	57000	52000	40000	22000	5000
6.0	4000	15000	23000	28000	30000	36000	37000	36000	30000	28000	23000	15000	4000
9.0	3000	7000	11000	13000	14000	14000	14000	14000	14000	13000	11000	7000	3000
12.0	1000	1500	2000	3000	4000	4500	5000	4500	4000	3000	2000	1500	1000

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUAT [illegible]

HORZ. ANGLES (H 13 13)

VERT.	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0
-48.0	500	1000	1500	1500	1500	1500	1500	1500	1500	1500	1500	1000	500
-40.0	1000	2500	3000	3500	4000	4000	4500	4000	4000	3500	3000	2500	1000
-32.0	1500	4000	5500	6500	7500	8500	9000	8500	7500	6500	5500	4000	1500
-24.0	2000	4500	8000	11500	12000	13000	13500	13000	12000	11500	8000	4500	2000
-16.0	2000	6000	12000	16000	17000	23000	24000	23000	17000	16000	12000	6000	2000
-8.0	2000	4000	15500	19500	22500	24500	25000	24500	22500	19500	15500	4000	2000
0.0	2000	3500	17000	21500	24500	27300	30000	27300	24500	21500	17000	3500	2000
8.0	2500	7500	14000	18500	22000	24000	25000	24000	22000	18500	14000	7500	2500
16.0	2000	5500	10000	[illegible]	15000	17000	18000	17000	15000	13000	10000	5500	2000
24.0	2000	4500	5500	9000	11000	12500	13000	12500	11000	9000	5500	4500	2000
32.0	1000	3000	4500	6000	7000	7500	8000	7500	7000	6000	4500	3000	1000
40.0	500	1500	3000	3300	3500	3700	4000	3700	3500	3300	3000	1500	500
48.0	200	300	500	1000	1000	1000	1000	1000	1000	1000	500	300	200

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LIGHT [illegible] [illegible] [illegible] TABLE NO. 50

HORZ. ANGLES (H 15 11)

VERT.	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0
-40.0	0	0	0	[illegible]	[illegible]	1100	1100	1100	1100	1100	1000	[illegible]	[illegible]	[illegible]	[illegible]
-30.0	0	[illegible]	1200	1300	1400	1500	1500	1500	1500	1500	1400	1300	1200	[illegible]	[illegible]
-20.0	400	1200	1700	2100	2500	2600	2600	2600	2600	2600	2500	2100	1700	1200	400
-10.0	1200	1900	2700	3500	4700	5600	5600	6300	6200	5600	4700	3500	2700	1900	1200
0.0	1500	3500	6300	8600	9600	10500	11300	11300	11300	10500	9600	8600	6300	3500	1500
10.0	1400	2600	5000	7600	9000	9300	9500	10000	[illegible]	9300	9000	7600	5000	2600	1400
20.0	1300	1600	2200	2800	3400	3400	3400	3400	3400	3400	3400	2800	2200	1600	1300
30.0	1200	1800	2400	2400	2400	2500	2500	2600	2500	2500	2400	2400	2400	1800	1200
40.0	900	1200	1300	1300	[illegible]	1700	[illegible]	2000	[illegible]	1700	[illegible]	1300	1300	1200	900
50.0	0	500	1150	1250	1300	1400	1500	1500	1500	1400	1300	1250	1150	500	0
60.0	0	0	0	0	0	[illegible]	1000	1000	1000	800	0	0	0	0	0

[illegible]

[illegible]

HORZ. ANGLES (H [illegible])

VERT.	20.0	30.0	40.0	50.0	[illegible]	70.0	[illegible]	90.0	100.0	110.0	120.0	130.0	140.0	150.0	[illegible]
-40.0	0	0	200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	400	700	700	200	0	[illegible]
-30.0	0	300	300	1000	1100	[illegible]	1400	1500	1400	1300	1100	1000	[illegible]	[illegible]	[illegible]
-20.0	300	900	1300	1700	2100	[illegible]	2400	2500	2400	2200	2100	1700	1300	900	[illegible]
-10.0	500	1500	2700	4000	[illegible]	5000	5100	5100	5100	5000	4500	4000	2700	1500	[illegible]
0.0	300	2400	4200	5400	[illegible]	[illegible]	7500	[illegible]	7500	6800	6200	5400	4200	2400	[illegible]
10.0	[illegible]	2300	3500	4600	5400	[illegible]	5000	6000	6000	5800	5400	4600	3500	2300	[illegible]
20.0	0	300	1400	2500	[illegible]	[illegible]	2400	2400	2400	[illegible]	3400	2500	1400	300	[illegible]
30.0	0	400	1400	1500	1500	[illegible]	1900	1900	1900	1900	1500	1500	1400	[illegible]	[illegible]
40.0	0	0	[illegible]	[illegible]	1000	[illegible]	1200	[illegible]	[illegible]	1100	1000	900	[illegible]	0	[illegible]
50.0	0	0	0	0	[illegible]	750	500	500	500	750	500	0	0	0	[illegible]

5/25

HORZ. (M 17 11)

VERT.	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0
-40.0	0	0	0	1000	1800	1800	1800	1000	1800	1800	1800	1500	1300	1000	0	0	0
-30.0	0	0	1500	2100	2200	2300	2300	2400	2400	2400	2300	2300	2200	2100	1500	0	0
-20.0	0	1800	2400	2700	2800	2800	3000	3100	3300	3100	3000	2900	2800	2700	2400	1500	[illegible]
-10.0	900	2400	4000	5200	5200	5800	7000	7000	7000	7000	7000	6600	6200	5200	4000	2600	500
0.0	3000	4800	8200	11800	15000	16800	17900	18000	18000	18000	17900	16400	15000	11800	8200	4800	2000
10.0	1000	4000	7500	11000	13200	15200	15500	15800	17200	15600	15800	15200	13200	11000	7500	4000	1000
20.0	500	2700	4500	5800	7000	7800	8400	8800	9000	8800	8400	7500	7000	5800	4500	2700	500
30.0	0	1600	2600	3500	4200	4700	5000	5100	5200	5100	5000	4700	4200	3500	2600	1500	0
40.0	0	500	2010	2210	2200	2400	2700	2800	2800	2800	2700	2430	2210	2210	2000	500	0
50.0	0	0	500	1800	2100	2200	2300	2500	2500	2500	2300	2200	2100	1800	500	0	0
60.0	0	0	0	0	800	1800	1800	1800	1800	1800	1800	1500	500	0	0	0	0

[illegible] TABLE OUTPUT

[illegible] TABLE [illegible] NO. 53

[illegible] (H [illegible])

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
-68.0	37	37	74	74	111	144	144	144	143	144	144	144	124	111	74	74	37	37
-60.0	55	111	[illegible]	[illegible]	[illegible]	2[illegible]3	2[illegible]3	221	221	221	221	2[illegible]3	2[illegible]3	14[illegible]	[illegible]	[illegible]	111	55
-52.0	74	148	959	1114	954	[illegible]	793	756	645	645	756	793	655	959	1114	954	148	74
-44.0	111	451	1444	[illegible]	1562	[illegible]	1494	1420	1180	1180	1420	1494	1577	[illegible]	1554	1444	[illegible]	111
-36.0	148	2231	2766	2654	[illegible]	2711	2536	2176	1715	1715	2176	2536	2711	[illegible]	2469	2766	2231	148
-28.0	155	2600	3204	3614	4001	3924	3923	3079	2120	2120	3079	3924	3924	4001	3614	32[illegible]	2600	155
-20.0	221	2840	3532	5151	5974	[illegible]	5472	5421	35[illegible]3	35[illegible]3	5421	5472	6635	5974	5151	3532	2840	221
-12.0	255	3008	3591	7412	7412	10406	10731	101[illegible]	[illegible]	[illegible]	1[illegible]	10731	10406	7412	7412	3591	30[illegible]	2[illegible]
-4.0	255	3153	4076	[illegible]	[illegible]	11[illegible]	12834	13[illegible]3	13792	13792	13663	12834	1193[illegible]	[illegible]	[illegible]	[illegible]	3153	[illegible]
4.0	245	2510	4130	5057	[illegible]11	12[illegible]	13534	13755	13[illegible]	13996	1[illegible]755	13534	125[illegible]	[illegible]11	[illegible]57	[illegible]	251[illegible]	245
12.0	240	3051	4039	7209	7600	11266	12544	10434	11377	11377	1[illegible]434	12544	11266	7800	7209	4039	3061	240
20.0	221	2914	3841	4942	5491	7671	7725	6454	4935	49[illegible]5	6454	7726	7671	5491	4942	[illegible]	2914	221
28.0	155	2055	3448	3925	4425	4314	4157	3134	2055	2065	3134	4157	4314	4425	3925	3448	2655	155
36.0	111	1623	3056	3314	[illegible]	2821	2454	2134	1715	171[illegible]	2134	2434	2821	[illegible]	[illegible]	[illegible]	1623	111

CANDLEPOWER TABLE PRINTOUT

[illegible] TABLE - [illegible] TABLE NO. [illegible]

HORZ. ANGLES (H [illegible])

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
44.0	74	203	2373	2409	2342	2047	1744	1560	1383	1343	1560	1744	2047	2342	2500	2374	203	74
52.0	37	124	719	1291	1199	1014	[illegible]	849	737	737	843	905	1014	1149	1041	719	129	47
60.0	37	74	111	194	203	203	203	221	221	221	221	203	203	203	194	111	74	37
68.0	0	37	37	74	74	111	148	148	148	148	148	148	111	74	74	37	37	0

B108

[illegible] TABLE PRINTOUT

[illegible] TABLE - [illegible] TABLE NO. 54

HORZ. ANGLES (H 16 14)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
-65.0	0	0	0	0	[illegible]	510	[illegible]	1120	1120	[illegible]	[illegible]	30	0	[illegible]	[illegible]	[illegible]
-55.0	0	0	247	3590	6060	7010	8150	1580	1580	8150	7010	6060	3590	247	0	0
-45.0	0	550	5490	7930	9920	10030	12080	13290	13290	12080	10030	9920	7930	5490	550	0
-35.0	0	3490	10110	11740	13010	13370	15510	16350	16350	15510	13370	13010	11740	10110	3490	0
-25.0	130	7520	13050	15550	17510	18750	24010	24300	24350	24010	18750	17510	15550	13050	7520	130
-15.0	260	3540	15460	18930	22290	25750	35170	45530	45530	35170	25750	22290	18930	15460	3540	260
-5.0	300	10160	17130	21400	25650	30540	42840	50900	56300	42840	30540	25650	21400	17130	10160	300
5.0	260	4920	17410	22010	26390	33470	46260	58120	58120	46260	33470	26390	22010	17410	4920	260
15.0	0	7550	15670	21250	25050	29250	40580	52760	52760	40580	29250	25050	21250	15670	7550	
25.0	0	6120	14830	19160	21770	24000	32110	41130	41130	32110	24000	21770	19160	14830	6120	0
35.0	0	2640	11260	15470	17310	17760	21500	25000	25000	21600	17760	17310	15470	11260	2640	0
45.0	0	540	6950	11630	12550	12520	14420	15460	15460	14420	12520	12550	11630	6950	540	0
55.0	0	0	1380	5120	4410	3370	4930	8940	8990	3580	4410	4510	5120	1380	[illegible]	0
65.	0	0	0	420	1040	1250	1261	1120	1120	1261	1250	1040	420	0	0	0

[illegible] OUTPUT

[illegible] TABLE NO. 55

HORZ. ANGLES (V [illegible] 12)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
-15.		245	245	235	130	220	167	159	116	43
	22	22	43	116	159	167	220	130	236	245
	245	236	130	220	167	159	115	43	22	22
	43	115	159	167	220	130	235	245	245	
-5.		918	918	905	227	882	667	544	366	150
	36	36	150	366	644	667	882	227	905	918
	918	905	227	882	667	644	366	150	36	36
	150	366	644	667	882	227	905	918	918	
5.0		2380	2380	2295	1544	2060	1913	1609	1073	644
	143	143	644	1073	1609	1913	2060	1544	2295	2380
	2380	2295	1544	2060	1913	1609	1073	644	143	143
	644	1073	1609	1913	2060	1544	2295	2380	2380	
15.		3515	3515	3368	2188	3003	2947	2660	2231	1609
	665	665	1609	2231	2660	2947	3003	2188	3368	3515
	3515	3368	2188	3003	2947	2660	2231	1609	665	665
	1609	2231	2660	2947	3003	2188	3368	3515	3515	
25.		4270	4270	4226	3067	3647	3505	3218	3003	2467
	1802	1802	2467	3003	3218	3505	3647	3067	4226	4270
	4270	4226	3067	3647	3505	3218	3003	2467	1802	1802
	2467	3003	3218	3505	3647	3067	4226	4270	4270	
35.		5148	5148	4676	3904	4204	4161	3818	3542	3110
	2681	2681	3110	3542	3818	4161	4204	3904	4676	5148
	5148	4676	3904	4204	4161	3818	3542	3110	2681	2681
	3110	3542	3818	4161	4204	3904	4676	5148	5148	
45.		5234	5234	5200	4376	4550	4419	4354	4183	3647
	3218	3218	3647	4183	4354	4419	4550	4376	5200	5234
	5234	5200	4376	4550	4419	4354	4183	3647	3218	3218
	3647	4183	4354	4419	4550	4376	5200	5234	5234	
55.		5190	5190	5212	5140	5470	5500	5191	4590	4290
	3792	3792	4290	4590	5191	5500	5470	5140	5212	5190
	5190	5212	5140	5470	5500	5191	4590	4290	3792	3792
	4290	4590	5191	5500	5470	5140	5212	5190	5190	

8110

[illegible] TABLE PRINTOUT

[illegible] TABLE - COMPUTATION CODE: [illegible] TABLE NO. 55

HORZ. ANGLES (V 3[illegible] - 12)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
45.0		5490	5490	5513	5320	5556	5577	5534	5320	4934
	4290	4290	4934	5320	5534	5577	5556	5320	5513	5490
	5490	5513	5320	5556	5577	5534	5320	4934	4290	4290
	4934	5320	5534	5577	5556	5320	5513	5490	5490	
75.		5277	5277	5405	5556	5513	5534	5534	5504	5363
	5084	5084	5363	5504	5534	5534	5513	5556	5405	5277
	5277	5405	5556	5513	5534	5534	5504	5363	5084	5084
	5363	5504	5534	5534	5513	5556	5405	5277	5277	
85.		5490	5490	5490	5490	5490	5490	5490	5490	5490
	5490	5490	5490	5490	5490	5490	5490	5490	5490	5490
	5490	5490	5490	5490	5490	5490	5490	5490	5490	5490
	5490	5490	5490	5490	5490	5490	5490	5490	5490	
90.0		5490	5490	5490	5490	5490	5490	5490	5490	5490
	5490	5490	5490	5490	5490	5490	5490	5490	5490	5490
	5490	5490	5490	5490	5490	5490	5490	5490	5490	5490
	5490	5490	5490	5490	5490	5490	5490	5490	5490	

SUPPORT RW TABLE PRINTOUT

SUPPORT RW TABLE - LOAD SIZE CODE: V40H5+LKEI TABLE NO. 55

HORZ. ANGLES (V 3- 12)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
-15.		616	729	486	220	190	207	265	387	396
	247	247	396	387	265	207	198	220	486	729
	516	693	666	324	225	202	180	180	194	194
	180	180	202	225	324	666	693	516	729	
-5.		999	2930	590	342	342	1143	2644	3938	2552
	706	706	2552	3938	2644	1143	342	342	590	2930
	999	540	464	356	215	176	162	171	180	180
	171	162	176	215	356	464	540	999	2930	
5.		494	1439	1132	1327	2515	3824	4725	4747	3186
	2942	2942	3186	4747	4725	3824	2515	1327	1132	1439
	494	415	423	360	220	180	165	157	171	171
	157	165	180	220	360	423	415	494	1439	
15.0		1017	11385	19676	7444	5328	4432	4806	6813	2142
	1822	1822	2142	6813	4806	4432	5328	7444	19676	11385
	1017	310	202	274	292	162	180	180	180	180
	180	180	162	292	274	202	310	1017	11385	
25.		1845	11346	48483	31195	11025	6804	5881	3028	1224
	1138	1138	1224	3028	5881	6804	11025	31195	48483	11346
	1845	465	238	211	153	139	153	171	162	152
	171	153	139	153	211	238	465	1845	11346	
35.		3951	6111	22846	45935	19309	13473	8136	4018	2848
	2205	2205	2848	4018	8136	13473	19309	45935	22846	6111
	3951	2470	1404	513	234	207	202	189	175	175
	189	202	207	234	513	1404	2470	3951	6111	
45.		4535	6484	10710	13936	23697	25429	20430	15876	10566
	6291	6291	10566	15876	20430	25429	23697	13936	10710	6484
	4535	4459	3919	3546	1962	1642	415	301	265	265
	301	415	1642	1962	3546	3919	4459	4535	6484	
55.		5242	5076	6741	10057	15354	19462	23710	32238	27765
	22149	22149	27765	32238	23710	19462	15354	10057	6741	5076
	5242	4648	4715	4383	4689	4234	3834	1575	557	557
	1575	3834	4234	4689	4383	4715	4648	5242	5076	

[illegible] TABLE PRINTOUT

[illegible] TABLE - LUMINAIRE CODE: V4505[illegible] TABLE NO. [illegible]6

HORZ. ANGLES (V 3/ 12)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
65.		3991	4270	4429	4873	7281	10422	13590	14949	13959
	11718	11718	13959	14949	13590	10422	7281	4873	4428	4270
	3991	4428	4351	4072	4554	5031	5044	3446	1075	1075
	3446	5044	5031	4554	4072	4351	4423	3991	4270	
75.0		4023	3222	2655	2668	3127	3661	4221	4675	4603
	4879	4978	4603	4675	4221	3661	3127	2568	2655	3222
	4023	4383	4648	4644	4968	4617	2547	3127	7825	7625
	3127	2547	4617	4968	4644	4648	4383	4023	3222	
85.0		4072	3964	3627	3321	3187	2452	2411	2764	2749
	2718	2718	2749	2764	2911	2452	3187	3321	3627	3964
	4072	4140	3942	3852	3919	4032	3919	4018	3928	3928
	4018	3919	4032	3919	3852	3942	4140	4072	3964	
90.0		3400	3400	3400	3400	3400	3400	3400	3400	3400
	3400	3400	3400	3400	3400	3400	3400	3400	3400	3400
	3400	3400	3400	3400	3400	3400	3400	3400	3400	3400
	3400	3400	3400	3400	3400	3400	3400	3400	3400	

B113

[illegible] TABLE PRINTOUT

[illegible] TABLE NO. 57

[illegible] (H 16 . 16)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
-75.	137	229	273	273	282	244	305	313	313	305	244	282	273	273	229	137
-65.	194	263	335	525	1594	3620	3923	4128	4128	3923	3620	1594	525	335	263	194
-55.0	210	285	2260	3450	4290	4990	6550	7915	7915	6550	4990	4290	3450	2260	285	210
-45.0	250	450	2230	6740	8020	9900	10730	9910	9910	10730	9900	8020	6740	2230	450	250
-35.0	280	1300	4670	6310	7920	9040	9860	9860	9860	9860	9040	7920	6310	4670	1300	280
-25.0	270	2070	3910	5110	8760	10740	13140	15550	15550	13140	10740	8760	5110	3910	2070	270
-15.0	260	1780	3060	5280	8220	11310	15050	18580	18580	15050	11310	8220	5280	3060	1780	260
-5.0	240	1400	2700	4450	8400	11530	14330	16670	16670	14330	11530	8400	4450	2700	1400	240
5.0	250	1420	2730	4370	8040	11140	14100	16170	16170	14100	11140	8040	4370	2730	1420	250
15.0	240	1510	3130	5030	8040	11340	14960	18250	18250	14960	11340	8040	5030	3130	1510	240
25.0	270	2010	4000	5370	8040	9500	11300	13080	13080	11300	9500	8040	5370	4000	2010	270
35.0	250	680	4620	6340	7660	9180	9820	9820	9820	9820	9180	7660	6340	4620	680	250
45.0	210	420	2170	6200	7950	9540	10460	9720	9720	10460	9540	7950	6200	2170	420	210
55.0	170	250	2055	3300	4365	5000	5635	5290	5290	5635	5000	4365	3300	2055	250	170

[illegible] TABLE PRINTOUT

[illegible] TABLE [illegible] CODE: [illegible] TABLE NO. [illegible]7

HORIZ. ANGLES (H 15 [illegible] 165)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0
	105.0	115.0	125.0	135.0	145.0	155.0	165.0		
65.[illegible]	19[illegible]	263	335	525	159[illegible]	352[illegible]	3923	4128	4125
3923	3528	1598	525	335	253	19[illegible]			
75.[illegible]	137	229	273	273	262	2[illegible]4	3[illegible]	313	313
3[illegible]	294	252	273	273	229	[illegible]57			

B115

[illegible] TABLE PRINTOUT

[illegible] TABLE - LUMINAIRE [illegible] TABLE NO. 53

HORIZ. ANGLES (H 15 1F)

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
-75.0	0	0	0	43	120	104	170	164	164	170	104	120	43	0	0	0
-65.0	0	155	230	327	462	540	546	690	690	546	540	462	327	230	155	0
-55.0	0	232	450	744	1124	1145	1360	1316	1316	1360	1145	1124	744	450	232	0
-45.0	132	310	1034	2009	2410	2464	2721	2730	2730	2721	2464	2410	2009	1034	310	132
-35.	263	368	2184	3738	4096	4364	4524	4506	4506	4524	4364	4096	3738	2184	368	263
-25.0	263	620	3390	4766	5622	6413	6462	6776	6776	6462	6413	5622	4766	3390	620	263
-15.0	263	775	4138	5327	6627	8514	9592	9934	9934	9592	8514	6627	5327	4138	775	263
-5.0	263	853	4425	5514	7550	9891	11803	12500	12500	11803	9891	7550	5514	4425	853	263
5.0	263	853	4425	5514	7550	9619	11544	12204	12204	11544	9619	7550	5514	4425	853	263
15.0	263	775	4080	2550	6787	8370	9354	9440	9440	9354	8370	6787	2550	4080	775	263
25.0	263	620	3390	4756	5542	6304	6599	6490	6490	6599	6304	5542	4766	3390	620	263
35.0	263	465	2241	3593	4016	4239	4323	4243	4243	4323	4239	4016	3593	2241	465	263
45.0	132	310	1034	2103	2209	2355	2440	2401	2401	2440	2355	2209	2103	1034	310	132
55.0	0	310	460	841	1044	1037	1253	1253	1253	1253	1037	1044	841	460	310	0

[illegible] TABLE [illegible]

[illegible] TABLE [illegible] TABLE NO. [illegible]

HORIZ. AXIS (M [illegible])

VERT.	15.0	25.0	35.0	45.0	55.0	65.0	75.0	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
65.	0	15[illegible]	2[illegible]7	4[illegible]	[illegible]02	[illegible]	[illegible]14	[illegible]	[illegible]	71[illegible]	[illegible]	5[illegible]	467	2[illegible]7	15[illegible]	0
75.[illegible]	0	[illegible]	[illegible]7	140	200	254	23[illegible]	2[illegible]	250	23[illegible]	254	220	140	[illegible]7	0	0

... TABLE PRINTOUT

... TABLE - CUMULATIVE COUNT ... TABLE NO. 59

HORIZ. ... (V 37 ...)

VERT.										
		0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0
	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
	190.0	200.0	210.0	220.0	230.0	240.0	250.0	260.0	270.0	280.0
	290.0	300.0	310.0	320.0	330.0	340.0	350.0	360.0		
0.0		1613	1534	1286	1025	731	437	262	216	181
	[illegible]	181	216	262	437	731	1025	1286	1538	1613
	1356	1105	919	644	400	237	200	144	150	194
	[illegible]	237	400	644	919	1105	1356	1513		
5.0		2481	2394	2150	1756	1250	819	481	331	294
	350	294	331	481	819	1250	1756	2150	2394	2481
	2219	1869	1594	1159	750	444	313	294	275	294
	313	444	750	1159	1594	1869	2219	2481		
10.0		3956	3850	3369	2600	2087	1400	569	559	475
	536	475	559	869	1400	2087	2600	3369	3850	3956
	3587	3112	2569	1900	1275	813	534	463	463	463
	532	813	1275	1900	2569	3112	3587	3956		
15.0		5669	5531	4944	4231	3250	2262	1500	1000	787
	[illegible]	737	1000	1500	2262	3250	4231	4944	5531	5669
	5225	4644	3936	3019	2100	1412	962	762	750	762
	962	1412	2100	3019	3939	4644	5225	5569		
20.0		7756	7612	6994	6156	4919	3550	2456	1756	1400
	1375	1400	1756	2456	3550	4919	6156	6994	7612	7756
	7244	6637	5856	4631	3350	2406	1756	1438	1325	1438
	1756	2406	3350	4631	5856	6637	7244	7756		
25.0		10300	10144	9437	8512	7125	5412	3594	2969	2344
	2506	2544	2969	3594	5412	7125	8512	9437	10144	10300
	9769	9031	8094	6700	4987	3631	2794	2350	2225	2350
	2794	3631	4987	6700	8094	9031	9769	10308		
30.0		13294	13112	12275	11294	9794	7425	5569	4550	4019
	3975	4019	4550	5669	7825	9794	11294	12275	13112	13294
	12563	11850	10519	9281	7244	5381	4175	3556	3550	3556
	4175	5381	7244	9281	10519	11850	12563	13294		
35.0		16481	16056	15500	14337	12781	10644	8359	6653	5869
	5819	5869	6653	8369	10644	12781	14337	15500	16056	16481
	16069	15394	13837	12269	10094	7464	6213	5431	5225	5431
	6213	7464	10094	12269	13887	15394	16069	16481		

B118

[illegible] TABLE OUTPUT

[illegible] TABLE - CONT. [illegible] TABLE NO. 59

HORZ. ANGLES (V 37 H).

VERT.										
	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	
	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
	190.0	200.0	210.0	220.0	230.0	240.0	250.0	260.0	270.0	280.0
	290.0	300.0	310.0	320.0	330.0	340.0	350.0	360.0		
40.0	21262	20394	19231	17612	15705	13549	11294	9456	8519	
	8425	8519	9456	11294	13549	15705	17612	19231	20394	21262
	20100	18750	17100	15231	13050	10600	8656	7719	7450	7719
	8656	10600	13050	15231	17100	18750	20100	21262		
45.0	27500	26575	23725	21213	18736	16394	14212	12425	11506	
	11525	11506	12425	14212	16394	18736	21213	23725	26575	27500
	25644	23262	20681	18213	15950	13550	11531	10481	10225	10481
	11531	13550	15950	18213	20681	23262	25644	27500		
50.0	36725	34506	29456	25575	22250	19375	17119	15544	14731	
	14875	14731	15544	17119	19375	22250	25575	29456	34506	36725
	33564	28881	24850	21719	18944	16451	14612	13562	13325	13562
	14612	16451	18944	21719	24850	28881	33564	36725		
55.0	50744	46125	37400	31344	26519	23356	20900	19200	18325	
	18457	18325	19200	20900	23356	26519	31344	37400	46125	50744
	45337	36819	30806	25556	23250	20625	18744	17625	17325	17625
	18739	20625	23250	25556	30806	36819	45337	50744		
60.0	67387	59819	46500	37965	32261	28244	25406	23594	22706	
	22725	22706	23594	25406	28244	32261	37965	46500	59819	67387
	58037	46069	37525	31875	27988	25303	23469	22175	21900	22175
	23469	25303	27988	31875	37525	46069	58037	67387		
65.0	83256	74131	57450	46350	39400	34625	31450	29519	28594	
	28625	28594	29519	31450	34625	39400	46350	57450	74131	83256
	73175	56956	45965	39081	34581	31638	29519	28050	27825	28050
	29519	31638	34581	39081	45965	56956	73175	83256		
70.0	98675	89031	71431	57819	49250	43431	39506	37337	36494	
	36700	36494	37337	39506	43431	49250	57819	71431	89031	98675
	87869	70356	57531	49350	43844	40069	37619	36056	35675	36056
	37619	40069	43844	49350	57531	70356	87869	98675		
75.0	112311	105644	88944	73937	63475	56414	51919	49269	48381	
	48831	48381	49269	51919	56414	63475	73937	88944	105644	112311
	102612	85869	72757	63181	56481	51606	48556	46919	47000	46919
	48556	51606	56481	63181	72757	85869	102612	112311		

B119

[illegible]

[illegible] VI[illegible] TABLE NO. 59

HORZ. ANGLES (V 37 19)

```
          0.0  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0
  90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0 170.0 180.0
 190.0 200.0 210.0 220.0 230.0 240.0 250.0 260.0 270.0 280.0
 290.0 300.0 310.0 320.0 330.0 340.0 350.0 360.0
VERT.

 90.0       124431121156109675 96731 86937 76137 72400 69606 68266
 68326 [illegible] 66625 72900 76137 86937 96731110575121156124431
 117844[illegible] 94067 84144 76725 71425 67775 [illegible]
 67775 71425 75725 84144 94067115125117544124431

 85.0       136766135794132819127875122538117913111353110981910766[illegible]
 [illegible]107469[illegible]113631117813122536127575132841135794136766
 133712128905122794116250110644106494104200102737104575102737
 104200106944110644116250122794128905133712136766

 90.0       169056169056169056169056169056169056169056169056169056
 169056169056169056169056169056169056169056169056169056169056
 169056169056169056169056169056169056169056169056169056169056
 169056169056169056169056169056169056169056169056
```

[illegible] PRINTOUT

[illegible] CODE: [illegible] TIME 0. [illegible]

HORZ. ANGLES (V 3 12)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
-15.0		322	408	275	132	115	110	140	235	200
	152	152	200	235	140	110	115	132	275	408
	322	365	350	170	114	102	80	73	95	55
	74	80	102	113	170	352	358	322	408	
-5.0		564	1618	452	1495	188	635	1456	2088	1518
	410	410	1515	2088	1454	635	150	145	350	1618
	564	290	248	188	110	65	70	70	75	75
	75	75	85	115	185	248	24	564	1615	
5.0		545	769	633	740	1320	1425	2313	2449	1750
	1722	1722	1750	2449	2313	1425	1320	740	633	769
	545	234	215	145	110	63	63	65	64	65
	64	63	63	110	145	215	234	545	769	
15.0		547	6241	10530	4072	2555	2207	2357	3587	1092
	1042	1042	1092	3587	2347	2207	2555	4072	10530	6241
	547	167	135	134	95	73	73	73	65	55
	73	73	73	95	133	135	167	547	6241	
25.0		1047	5333	24259	16131	5561	3547	2595	1542	645
	617	611	645	1542	2545	3547	5550	16131	24259	5333
	1047	257	145	110	73	60	59	59	65	55
	60	60	60	73	110	145	257	1047	5333	
35.0		2190	3097	10962	23657	10042	7262	4327	2160	1530
	1160	1160	1530	2190	4327	7262	10042	23557	10962	3097
	2160	1382	620	322	140	93	90	73	66	65
	73	90	93	140	322	620	1382	2160	3097	
45.0		2527	3465	5612	7155	11927	13237	10862	8645	5615
	3447	3497	5615	3545	10862	13237	11927	7155	5612	3465
	2527	2447	2172	1965	1372	445	213	132	117	117
	132	213	445	1372	1965	2172	2447	2527	3465	
55.0		3015	2837	3732	5450	7657	10062	11942	16502	14335
	11645	11645	14335	16502	11942	10062	7657	5450	3732	2837
	3015	2592	2545	2345	2435	2205	2132	932	315	315
	932	2132	2205	2435	2345	2545	2592	3015	2837	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] TABLE NO. 60

HORZ. ANGLES (V 3- 12)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
65.0		2175	2297	2415	2515	3635	5500	6565	7430	6927
	6932	6932	6927	7430	6645	5500	3645	2515	2415	2297
	2175	2435	2352	2220	2385	2742	2542	1832	577	577
	1832	2692	2702	2355	2222	2382	2435	2175	2297	
75.0		2165	1742	1440	1435	1632	1900	2150	2340	2360
	2490	2490	2360	2340	2150	1900	1632	1435	1440	1742
	2165	2372	2555	2557	2887	2357	1332	1700	4352	4352
	1700	1332	2357	2587	2557	2555	2372	2165	1742	
85.0		2177	2195	1922	1752	1611	1532	1455	1410	1412
	1397	1397	1412	1410	1435	1532	1611	1752	1922	2195
	2177	2217	2145	2095	2110	2155	2152	2157	2045	2095
	2157	2102	2165	2110	2095	2145	2217	2177	2165	
90.0		1800	1800	1800	1800	1800	1800	1800	1800	1800
	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
	1800	1800	1800	1800	1800	1800	1800	1800	1800	

[illegible] TABLE PRINTOUT

[illegible] TABLE - [illegible] TABLE NO. 61

HORZ. METERS (H [illegible])

VERT.									
	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0
	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
-68.	72	72	145	145	217	253	289	289	289
	289	289	289	253	217	145	145	72	72
-60.0	109	217	253	325	289	348	398	434	434
	434	434	398	398	289	326	253	217	109
-52.0	145	289	1380	1488	1881	1699	1554	1482	1265
	1265	1482	1554	1699	1880	1988	1880	289	145
-44.0	217	904	3615	3632	3651	3327	2929	2784	2314
	2314	2784	2929	3327	3651	3632	3615	904	217
-36.	289	4374	5423	5721	5765	5315	4953	4265	3353
	3353	4265	4953	5315	5765	5721	5423	4374	289
-28.0	325	5094	6240	7066	7646	7701	7701	6037	4157
	4157	6037	7701	7701	7646	7066	6240	5094	325
-20.0	434	5568	7122	10160	11714	13015	12690	10630	6869
	6869	10630	12690	13015	11714	10160	7122	5568	434
-12.0	506	5894	7629	14534	14534	20391	21041	19921	14234
	14234	19921	21041	20391	14534	14534	7629	5894	506
-4.0	506	6152	7990	15835	15378	23391	25164	26790	27044
	27044	26790	25164	23391	15378	15835	7990	6152	506
4.0	578	5116	8099	15799	16884	24555	26537	26971	27441
	27441	26971	26537	24555	16884	15799	8099	5116	578
12.0	470	6002	7918	14136	15294	22090	24694	21439	22307
	22307	21439	24694	22090	15294	14136	7918	6002	470
20.0	434	5713	7629	9689	12727	15040	15149	12654	9617
	9617	12654	15149	15040	12727	9689	7629	5713	434
28.0	325	5266	6761	7791	8677	8461	8171	6145	4049
	4049	6145	8171	8460	8677	7791	5761	5266	325
36.	217	3152	5514	5517	5254	5532	4541	4144	3353
	3353	4144	4841	5532	5254	5517	5514	3152	217

[illegible] TABLE PRINTOUT

[illegible] TABLE - [illegible] TABLE NO. 61

HORIZ. ANGLES (H [illegible])

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0
44.0	147	390	4604	5098	4591	4013	3507	3254	2712
52.0	72	253	1410	2631	2350	1498	1771	1663	1446
60.0	72	145	217	362	398	398	398	434	434
68.0	0	72	72	145	145	217	289	289	289

VERT.	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
44.0	2712	3254	3507	4013	4541	5098	4604	390	147
52.0	1446	1663	1771	1498	2350	2631	1410	253	72
60.0	434	434	398	398	398	362	217	145	72
68.0	289	289	289	217	145	145	72	72	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 62

VERT. \ HORZ. ANGLES (H 1- 18)	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
-68.0	0	0	34	103	172	241	275	275	344	344	275	275	241	172	103	34	0	0
-60.0	69	69	103	172	241	275	344	344	413	413	344	344	275	241	172	103	69	69
-52.0	69	103	172	241	275	344	413	413	447	447	413	413	344	275	241	172	103	69
-44.0	138	550	1410	2477	3440	3784	4369	4644	4300	4300	4644	4369	3784	3440	2477	1410	550	138
-36.0	241	963	2236	3440	4541	4850	5538	5263	5573	5573	5263	5538	4850	4541	3440	2236	963	241
-28.0	413	1376	2993	4732	5620	6536	7396	7086	7602	7602	7086	7396	6536	5620	4732	2993	1376	413
-20.0	516	1720	4059	6467	8256	9288	10458	10354	10802	10802	10354	10458	9288	8256	6467	4059	1720	516
-12.0	482	1995	5022	8462	11490	13554	15446	15377	16065	16065	15377	15446	13554	11490	8462	5022	1995	482
-4.	585	2546	6605	11627	15492	18954	21878	21741	22635	22635	21741	21878	18954	15492	11627	6605	2546	585
4.	516	2408	6605	11352	15755	18866	21810	21913	22979	22979	21913	21810	18866	15755	11352	6605	2408	516
12.	516	2167	5470	8944	11937	13956	15962	15962	16581	16581	15962	15962	13956	11937	8944	5470	2167	516
20.0	447	1720	4094	6605	8566	9598	10870	10733	11111	11111	10733	10870	9598	8566	6605	4094	1720	447
28.0	378	1410	3096	4919	6192	6777	7774	7465	7979	7979	7465	7774	6777	6192	4919	3096	1410	378
36.0	241	1032	2167	3578	4644	4988	5745	5401	5745	5745	5401	5745	4988	4644	3578	2167	1032	241

B125

CANDLEPOWER TABLE PRINTOUT

[illegible] TABLE - [illegible] TABLE NO. 62

HORZ. ANGLES (H [illegible])

VERT.	22.0	30.0	38.0	46.0	54.0	62.0	70.0	78.0	86.0	94.0	102.0	110.0	118.0	126.0	134.0	142.0	150.0	158.0
44.0	172	551	1479	2546	3612	3853	4472	4162	[illegible]	[illegible]	4162	4472	3853	3612	2546	1479	551	172
52.0	[illegible]	103	172	241	275	344	413	413	447	447	413	413	344	275	241	172	103	69
60.0	69	69	103	172	241	275	344	334	413	413	334	344	275	241	172	103	69	69
68.0	0	0	69	103	172	241	275	275	344	344	275	275	241	172	103	69	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] V25 [illegible] TABLE NO. 53

HORIZ. ANGLES (V [illegible])

		-2.5	2.5	5.0	7.5	12.5	15.0	17.5	22.5	25.0
	27.5	35.0	45.0	55.0	65.0	75.0	85.0	90.0	95.0	105.0
	115.0	125.0	135.0	145.0	152.5	155.0	157.5	162.5	165.0	167.5
	172.5	175.0	177.5	182.5	185.0	187.5	192.5	195.0	197.5	202.5
	205.0	207.5	215.0	225.0	235.0	245.0	255.0	265.0	275.0	285.0
	295.0	305.0	315.0	325.0	332.5	335.0	337.5	342.5	345.0	347.5
	352.5	355.0	357.5	362.5						
VERT.										
-35.0		30	30	30	30	30	30	30	30	30
	30	30	30	30	30	30	30	30	30	30
	30	30	30	30	30	30	30	30	30	30
	30	30	30	30	30	30	30	30	30	30
	30	30	30	30	30	30	30	30	30	30
	30	30	30	30	30	30	30	30	30	30
	30	30	30	30						
-25.0		95	115	54	55	45	45	45	45	45
	45	45	30	30	30	30	30	30	30	30
	30	30	30	45	45	45	45	45	45	45
	66	54	115	45	74	60	30	15	18	26
	30	30	30	30	30	30	30	30	30	30
	30	30	30	30	30	30	25	14	15	30
	6	74	95	115						
-15.0		183	201	234	231	215	208	180	171	164
	163	144	145	174	134	134	104	89	104	134
	134	164	148	149	153	164	171	186	205	215
	231	233	201	187	164	145	105	59	74	44
	30	30	30	30	30	30	30	30	30	30
	30	30	30	30	30	30	44	74	89	104
	145	164	183	201						
-5.0		262	257	311	315	323	325	319	314	311
	240	268	246	252	252	223	205	200	206	223
	252	252	296	262	240	311	314	319	325	323
	315	311	287	262	234	223	183	179	167	134
	119	105	69	74	30	30	30	30	30	30
	30	30	74	89	105	119	134	167	179	193
	223	234	252	287						
2.5		357	446	534	563	638	640	742	816	824
	83	446	771	371	336	259	256	252	256	259
	336	371	771	[illegible]	[illegible]	624	615	742	540	638
	563	534	446	357	325	248	252	238	223	205
	166	174	156	164	154	115	95	75	75	96
	115	164	104	156	176	136	[illegible]	223	238	252
	246	325	357	446						

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE [illegible] VERTICAL [illegible] TABLE NO. 63

HORZ. ANGLES (V 63 3)										
		-2.5	2.5	5.0	7.5	12.5	15.0	17.5	22.5	25.0
	27.5	35.0	45.0	55.0	65.0	75.0	85.0	90.0	95.0	105.0
	115.0	125.0	135.0	145.0	152.5	155.0	157.5	162.5	165.0	167.5
	172.5	175.0	177.5	182.5	185.0	187.5	192.5	195.0	197.5	202.5
	205.0	207.5	215.0	225.0	235.0	245.0	255.0	265.0	275.0	285.0
	295.0	305.0	315.0	325.0	332.5	335.0	337.5	342.5	345.0	347.5
	352.5	355.0	357.5	362.5						
VERT.										
5.0		416	579	683	773	961	1114	1160	1340	1410
	1425	1040	890	400	357	258	265	268	258	268
	357	400	890	1040	1425	1410	1340	1160	1114	980
	773	683	579	416	372	357	252	265	235	193
	209	193	179	193	228	145	115	89	89	118
	143	268	143	179	143	228	143	235	258	252
	357	372	416	579						
7.5		1335	400	504	609	847	995	1140	2230	2000
	177	2617	1352	571	472	379	364	355	364	379
	472	571	1352	2617	1770	2000	2230	1140	995	847
	609	504	400	1336	1245	1165	877	788	699	238
	272	223	230	241	242	185	155	141	141	156
	185	242	241	230	223	272	238	599	788	877
	1165	1245	1336	400						
10.0		803	1243	1510	1930	2652	3020	3392	4030	4250
	4440	4192	1873	742	567	491	461	445	461	491
	567	742	1873	4192	4440	4250	4030	3392	3020	2652
	1930	1510	1243	803	677	551	355	341	296	253
	335	252	252	239	273	222	193	193	143	193
	222	273	239	282	252	335	253	295	341	385
	551	677	803	1240						
12.5		1410	2241	2780	3315	4590	5300	5970	7065	7065
	7065	5770	2364	913	701	602	555	533	556	602
	701	913	2364	5770	7065	7065	7065	5970	5300	4640
	3315	2780	2241	1410	1165	921	551	458	395	372
	305	342	334	337	309	259	231	244	244	231
	259	309	337	334	342	398	372	385	468	551
	921	1165	1410	2240						
15.0		2445	3953	4794	5890	8060	9030	10225	11440	10910
	10740	7340	2850	1080	816	714	653	622	653	714
	816	1080	2850	7340	10740	10910	11440	10225	9030	8060
	5890	4794	3953	2445	1915	1470	877	714	649	452
	442	431	365	345	342	298	257	295	246	258
	298	342	345	345	431	462	462	559	714	877
	1470	1915	2445	3950						

3/28

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - COMPUTER [illegible] TABLE NO. 53

```
HORZ. ANGLES  (V    53    53)
          -2.5   2.5    5.0    7.5   12.5   15.0   17.5   22.5   25.0
   27.5   35.0   45.0   55.0   65.0   75.0   85.0   90.0   95.0  105.0
  115.0  125.0  135.0  145.0  152.5  155.0  157.5  162.5  165.0  167.5
  172.5  175.0  177.5  182.5  185.0  187.5  192.5  195.0  197.5  202.5
  205.0  207.5  215.0  225.0  235.0  245.0  255.0  265.0  275.0  285.0
  295.0  305.0  315.0  325.0  332.5  335.0  337.5  342.5  345.0  347.5
  352.5  355.0  357.5  362.5
VERT.

17.5             4131   6630   8100   9563  12450  13940  14920  15070  14130
  13180   8335   3320   1600   1140    451    745    715    745    451
   1140   1600   3320   8335  13180  14130  15070  14920  13940  12450
   9563   8100   6630   4130   3330   2525   1410   1130    847    625
    562    575    456    426    401    370    375    347    347    375
    370    401    426    456    515    569    625    847   1130   1410
   2525   3330   4130   6630

20.0             5712   9103  11200  13255  17085  18100  19125  18310  16790
  14275   4110   3790   2110   1450   1190    935    410    935   1190
   1450   2110   3790   4110  15275  16790  18310  19125  18100  17085
  13255  11200   9103   5710   4450   3190   1724   1360    995    714
    675    633    527    468    461    445    435    399    399    403
    445    461    468    527    634    675    714    995   1360   1724
   3190   4450   5710   9105

22.5             6911  10991  13130  15070  15130  18580  19020  17620  15950
  15255   9435   4250   2740   1785   1425   1030    903   1030   1425
   1785   2760   4250   8835  14280  15950  17620  19020  18580  15130
  15070  13130  10991   6910   5470   4030   2140   1555   1230    962
    764    742    597    564    520    520    540    451    451    540
    520    520    564    597    742    764    962   1230   1555   2140
   4030   5470   6910  10990

25.0             6809  10695  12650  14660  17620  18280  18160  16140  14870
  13005   6570   4720   3140   2110   1660   1220    947   1220   1660
   2110   3140   4720   6570  13005  14870  16140  18160  18280  17620
  14660  12650  10665   6810   5355   4000   2240   1740   1365    979
    694    947    664    551    579    594    699    592    592    699
    594    579    551    664    847    694    979   1365   1740   2240
   4000   5355   6810  10690

27.5             6426   9435  11970  12530  14450  14625  14750  13820  12340
  11880   4225   5310   3350   2315   1470   1600   1590   1600   1470
   2315   3350   5310   9225  11880  12340  13820  14750  14625  14450
  12530  11970   9435   6425   5255   4100   2550   2120   1590   1245
   1155   1130    843    813    761    747    929    578    676    929
    747    761    813    843   1130   1150   1245   1590   2120   2550
   4100   5265   6425   9435
```

B129

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - COMPARISON OF VERSSEMAEL TABLE NO. 53

HOR-Z. ANGLES (V 53 3)

	-2.5	2.5	5.0	7.5	12.5	15.0	17.5	22.5	25.0
27.5	35.0	45.0	55.0	65.0	75.0	85.0	90.0	95.0	105.0
115.0	125.0	135.0	145.0	152.5	155.0	157.5	162.5	165.0	167.5
172.5	175.0	177.5	182.5	185.0	187.5	192.5	195.0	197.5	202.5
205.0	207.5	215.0	225.0	235.0	245.0	255.0	265.0	275.0	285.0
295.0	305.0	315.0	325.0	332.5	335.0	337.5	342.5	345.0	347.5
352.5	355.0	357.5	362.5						

VERT.

VERT.										
30.0		5661	8135	9470	10810	12775	13100	13440	12700	12030
	11475	4880	5900	3570	2520	2285	1970	2090	1970	2285
	2520	3570	5900	9890	11475	12090	12700	13440	13100	12775
	10810	9470	8135	5660	4730	3800	2650	2360	2065	1735
	1420	1660	1220	1070	944	893	959	853	853	959
	893	944	1070	1220	1660	1420	1735	2065	2360	2650
	3800	4730	5660	8135						
35.0		6222	6739	7500	8380	10130	11020	11405	12130	12570
	11880	11190	7090	4000	2930	2410	2730	2540	2730	2910
	2930	4000	7090	11190	11880	12570	12130	11405	11020	10130
	9380	7500	6739	6220	4460	3985	3030	2550	2400	2095
	1960	1360	1770	1590	1304	1200	1220	1205	1205	1220
	1200	1304	1590	1770	1360	1950	2095	2400	2550	3030
	3985	4460	6220	6740						
45.0		4660	5974	6630	7470	9150	9995	10210	10420	10440
	9870	8400	6710	4590	3570	3035	2435	2135	2435	3035
	3570	4590	6710	8400	9870	10440	10420	10210	9995	9150
	7470	6630	5974	4660	4000	3635	2445	2525	2340	2100
	1960	1970	1730	1460	1275	1260	1250	1230	1230	1250
	1260	1275	1460	1730	1970	1960	2100	2340	2525	2445
	3635	4000	4660	5975						
55.0		2785	2542	2420	3160	4700	5400	5780	6450	6760
	6860	5960	6430	5610	5150	4360	3700	3365	3700	4360
	5100	5610	6460	6960	6860	6760	6450	5780	5460	4700
	3160	2420	2542	2785	2410	2590	2250	2035	1955	1725
	1620	1525	1425	1350	1321	1340	1560	1410	1410	1660
	1340	1321	1350	1425	1525	1620	1725	1955	2035	2250
	2690	2410	2785	2540						
65.0		2370	2745	2933	3174	3660	3900	4120	4550	4770
	5075	5330	5640	5710	5710	5250	5000	4570	5000	5250
	5710	5710	5640	5330	5075	4770	4550	4120	3900	3660
	3174	2933	2745	2370	2180	2035	1740	1590	1535	1365
	1280	1230	1170	1140	1140	1230	1280	1250	1250	1280
	1230	1140	1140	1170	1230	1240	1365	1535	1590	1740
	2035	2180	2370	2745						

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V25[illegible] TABLE NO. 63

HORZ. ANGLES (7 63 23)

		-2.5	2.5	5.0	7.5	12.5	15.0	17.5	22.5	25.0
	27.5	35.0	45.0	55.0	65.0	75.0	85.0	90.0	95.0	105.0
	115.0	125.0	135.0	145.0	152.5	155.0	157.5	162.5	165.0	167.5
	172.5	175.0	177.5	182.5	185.0	187.5	192.5	195.0	197.5	202.5
	205.0	207.5	215.0	225.0	235.0	245.0	255.0	265.0	275.0	285.0
	295.0	305.0	315.0	325.0	332.5	335.0	337.5	342.5	345.0	347.5
	352.5	355.0	357.5	362.5						
VERT.										
75.0		2095	2055	2535	2634	2830	2930	3073	3370	3490
	3790	4080	4550	4900	4975	5151	5380	5495	5380	5151
	4975	4900	4550	4080	3790	3490	3370	3073	2930	2830
	2634	2535	2055	2095	1945	1840	1635	1530	1530	1530
	1280	1210	1140	1070	1025	1040	1040	1085	1085	1040
	1040	1025	1070	1140	1210	1280	1530	1530	1530	1635
	1840	1945	2095	2055						
95.0		2415	2402	2576	2614	2690	2730	2770	2875	2910
	2970	3035	3260	3410	3570	3700	3800	3850	3800	3700
	3570	3410	3260	3035	2970	2910	2875	2770	2730	2690
	2614	2576	2402	2415	2360	2315	2215	2170	2170	2170
	1990	1920	1855	1770	1660	1650	1635	1620	1620	1635
	1650	1660	1770	1855	1920	1990	2170	2170	2170	2215
	2315	2360	2415	2400						
90.0		2609	2609	2609	2609	2609	2609	2609	2609	2609
	2609	2609	2609	2609	2609	2609	2609	2609	2609	2609
	2609	2609	2609	2609	2609	2609	2609	2609	2609	2609
	2609	2609	2609	2609	2609	2609	2609	2609	2609	2609
	2609	2609	2609	2609	2609	2609	2609	2609	2609	2609
	2609	2609	2609	2609	2609	2609	2609	2609	2609	2609
	2609	2609	2609	2609						

[illegible]

[illegible]

[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	75.0
	[illegible]	[illegible]	[illegible]	115.0	[illegible]	[illegible]	[illegible]	[illegible]	165.0	175.0
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]										
[illegible]		7[illegible]	7[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	75
	7[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	75	
[illegible]		12[illegible]	12[illegible]	132	13[illegible]	122	12[illegible]	115	112	104
	[illegible]	[illegible]	104	112	11[illegible]	12[illegible]	122	13[illegible]	132	124
	12[illegible]	125	11[illegible]	1[illegible]	92	54	7[illegible]	5[illegible]	38	38
	[illegible]	75	[illegible]	92	1[illegible]	11[illegible]	12[illegible]	125	126	
-5.[illegible]		[illegible]	[illegible]	40	[illegible]	[illegible]	[illegible]	[illegible]	10[illegible]	100
	[illegible]	92	100	100	[illegible]2	52	[illegible]	38	40	40
	[illegible]	34	[illegible]	4[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	108	108
	[illegible]	7[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
5.[illegible]		171	180	204	231	272	34[illegible]	512	586	484
	2[illegible]3	263	484	5[illegible]	512	[illegible]	272	231	204	180
	171	143	1[illegible]3	199	2[illegible]4	266	[illegible]	273	156	156
	273	309	256	2[illegible]4	1[illegible]	1[illegible]3	1[illegible]3	171	180	
15.[illegible]		3106	3181	3393	3737	41[illegible]	[illegible]	3[illegible]71	25[illegible]1	1312
	1026	1026	1312	2501	3571	42[illegible]	419[illegible]	3737	3393	3181
	31[illegible]	[illegible]171	3287	3431	[illegible]	[illegible]	27[illegible]1	1056	7[illegible]	780
	10[illegible]	[illegible]701	337[illegible]	35[illegible]	3431	3287	3171	3106	3181	
25.[illegible]		7[illegible]3	7[illegible]3	752[illegible]	7[illegible]	[illegible]	44[illegible]	3736	3[illegible]1	2561
	22[illegible]1	2231	2561	3[illegible]1	3735	[illegible]	[illegible]3	7563	75[illegible]	7543
	7423	7303	7033	6333	417[illegible]	3321	2831	2171	1900	1900
	2171	[illegible]631	3321	[illegible]17[illegible]	[illegible]333	7[illegible]33	73[illegible]3	742[illegible]	7543	
35.[illegible]		[illegible]300	6335	[illegible]	[illegible]	[illegible]	4727	4462	4147	[illegible]566
	3297	[illegible]297	3566	4147	4462	4727	[illegible]	[illegible]	[illegible]	[illegible]335
	[illegible]300	[illegible]172	[illegible]	[illegible]	43[illegible]	4[illegible]91	3761	3181	2934	2934
	3181	3761	4091	4382	5222	[illegible]	6172	6300	6335	
45.[illegible]		[illegible]	[illegible]981	[illegible]963	[illegible]	[illegible]	[illegible]	[illegible]	4997	4465
	42[illegible]	[illegible]265	44[illegible]	4[illegible]7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]3	[illegible]981
	[illegible]	[illegible]	5681	[illegible]475	5213	[illegible]	[illegible]	[illegible]7	3848	3848
	4[illegible]7	[illegible]	4[illegible]	[illegible]213	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

B132

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] TABLE NO. [illegible]

HORZ. ANGLES (V [illegible])

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
55.0		6194	6232	6225	6162	6146	5440	5705	5456	5057
	4848	4849	5057	5456	5705	5642	6145	6162	6225	6232
	5144	[illegible]	5475	5795	5553	5322	[illegible]	4282	4469	4469
	4542	5152	5322	5553	5795	5475	[illegible]	5194	6232	
65.0		6641	6659	6645	5616	6539	6423	6250	6010	5762
	5604	5604	5762	6010	6250	6423	6539	6513	6645	6659
	6641	6574	6477	6335	6158	5945	[illegible]	5427	5264	5264
	5427	5709	5946	6159	6335	6477	6574	6641	6659	
75.0		6367	6373	6361	6337	6203	6172	6034	5422	5828
	5742	5762	5828	5422	6034	6172	6243	6337	6361	6373
	6367	6323	6246	6144	5020	5672	5742	5633	5558	5558
	5633	5742	5872	6020	6144	6246	6323	6367	6373	
85.0		5749	5751	5754	5756	5744	5730	5716	5702	5688
	5674	5674	5688	5702	5716	5730	5744	5756	5754	5751
	5749	5747	5744	5696	5675	5653	5631	5609	5588	5588
	[illegible]	5631	5653	5675	5696	5744	5747	5749	5751	
90.0		5725	5725	5725	5725	5725	5725	5725	5725	5725
	5725	5725	5725	5725	5725	5725	5725	5725	5725	5725
	5725	5725	5725	5725	5725	5725	5725	5725	5725	5725
	5725	5725	5725	5725	5725	5725	5725	5725	5725	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] TABLE NO. 65

HORZ. ANGLES (V 3, 17)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
VERT.										
-5.0		350	350	360	375	430	450	570	430	300
	170	160	170	300	430	570	450	430	375	360
	360	350	350	375	430	450	570	430	300	170
	170	300	430	570	450	430	375	360	350	350
0.0		470	470	510	590	640	745	1150	860	435
	300	300	300	435	860	1150	745	640	590	510
	470	470	510	590	640	745	1150	860	435	300
	300	435	860	1150	745	640	590	510	470	470
5.0		840	840	855	870	870	1550	2170	1440	780
	540	450	540	780	1440	2170	1550	870	870	855
	840	840	855	870	870	1550	2170	1440	780	540
	540	730	1440	2170	1550	870	870	855	840	840
10.0		1720	1720	1720	1700	2550	3460	3900	2120	1290
	780	720	780	1290	2120	3900	3460	2550	1700	1720
	1720	1720	1720	1700	2550	3460	3900	2120	1290	780
	780	1290	2120	3900	3460	2550	1700	1720	1720	1720
12.5		2400	2400	2500	2600	5150	5440	4320	2280	1700
	900	900	900	1700	2280	4320	5440	5150	2500	2500
	2400	2400	2500	2600	5150	5440	4320	2280	1700	900
	900	1700	2280	4320	5440	5150	2600	2500	2400	2400
15.0		3450	3450	3900	5150	6890	7320	4700	2350	1730
	1080	880	1080	1730	2350	4700	7320	6890	5150	3900
	3450	3450	3900	5150	6890	7320	4700	2350	1730	1080
	1080	1730	2350	4700	7320	6890	5150	3900	3450	3450
17.5		5750	5750	6330	7320	7470	7500	4500	2320	1750
	1250	1120	1250	1750	2320	4500	7500	7470	7320	6330
	5750	5750	6330	7320	7470	7500	4500	2320	1750	1250
	1250	1750	2320	4500	7500	7470	7320	6330	5750	5750
20.0		7320	7320	7780	8000	8400	6890	3900	2200	1870
	1430	1360	1430	1870	2200	3900	6890	8400	8000	7780
	7320	7320	7780	8000	8400	6890	3900	2200	1870	1430
	1430	1870	2200	3900	6890	8400	8000	7780	7320	7320

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: V1-[illegible] T HLF NO. 65

HORZ. ANGLES (V 39 17)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
VERT.										
25.0		8250	8250	8600	7960	7320	4730	3020	2430	2170
	1775	1720	1775	2170	2430	3020	4730	7320	7960	8600
	8250	8250	8600	7960	7320	4730	3020	2430	2170	1775
	1775	2170	2430	3020	4730	7320	7960	8600	8250	8250
30.0		8000	8000	7760	7100	5500	3400	3230	2720	2410
	2200	2150	2200	2410	2720	3230	3400	5500	7100	7760
	8000	8000	7750	7100	5500	3400	3230	2720	2410	2200
	2200	2410	2720	3230	3400	5500	7100	7760	8000	8000
35.0		7150	7150	6800	6100	5150	4040	3600	3020	2800
	2650	2600	2650	2800	3020	3600	4040	5150	6100	6800
	7150	7150	6800	6100	5150	4040	3600	3020	2800	2650
	2650	2800	3020	3600	4040	5150	6100	6800	7150	7150
45.0		5800	5600	5650	5160	4770	4600	4100	3660	3400
	3200	3170	3200	3400	3660	4100	4600	4770	5160	5650
	5800	5800	5650	5160	4770	4600	4100	3660	3400	3200
	3200	3400	3660	4100	4600	4770	5160	5650	5800	5800
55.0		5600	5600	5500	5300	5250	5100	4450	4100	3920
	3670	3600	3670	3920	4100	4450	5100	5250	5300	5500
	5600	5600	5500	5300	5250	5100	4450	4100	3920	3670
	3670	3920	4100	4450	5100	5250	5300	5500	5600	5600
65.0		6030	6030	5900	5620	5350	5050	4730	4440	4300
	4000	3930	4000	4300	4440	4730	5050	5350	5620	5900
	6030	6030	5900	5520	5350	5050	4730	4440	4300	4000
	4000	4300	4440	4730	5050	5350	5620	5900	6030	6030
75.0		5370	5370	5280	5150	5050	4940	4750	4600	4400
	4310	4310	4310	4400	4600	4750	4940	5050	5160	5280
	5370	5370	5280	5160	5050	4940	4750	4600	4400	4310
	4310	4400	4600	4750	4940	5050	5160	5280	5370	5370
85.0		4730	4730	4720	4700	4670	4640	4550	4570	4500
	4450	4460	4450	4500	4570	4650	4640	4570	4700	4720
	4730	4730	4720	4700	4670	4640	4650	4570	4500	4450
	4450	4500	4570	4550	4640	4670	4700	4720	4730	4730

B135

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE COORD VIRTUAL TABLE NO. 55

HORZ. ANGLES (V 39 17)

		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
VERT.										
90.0		4554	4554	4554	4554	4554	4554	4554	4554	4554
	4554	4554	4554	4554	4554	4554	4554	4554	4554	4554
	4554	4554	4554	4554	4554	4554	4554	4554	4554	4554
	4554	4554	4554	4554	4554	4554	4554	4554	4554	4554

B13C

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: [illegible] TABLE NO. 66

HORZ. ANGLES (H 14 15)

VERT.	39.0	45.0	51.0	57.0	63.0	69.0	75.0	81.0	87.0
-45.0	0	0	0	0	0	0	0	92	366
-39.0	0	0	0	0	615	978	1040	1017	1097
-33.0	0	0	235	762	1537	1466	1415	1479	1371
-27.0	0	0	353	1523	1644	1955	1890	1848	1828
-21.0	0	260	940	1959	2356	2542	2363	2403	2377
-15.0	0	1290	1645	2720	3074	3519	3497	3604	3656
-9.0	145	2455	2703	4026	5020	5376	6333	5915	6309
-3.0	145	3620	6463	6311	8914	10954	12476	13216	14260
3.0	0	3100	4465	7073	10143	12414	13800	13956	14260
9.0	0	2325	3290	4135	5020	5665	5616	6747	6764
15.0	0	130	2115	2938	3279	3617	3592	3604	3748
21.0	0	0	705	2067	2459	2542	2457	2403	2468
27.0	0	0	119	1088	1644	1857	1890	1756	1828
33.0	0	0	0	219	1025	1466	1323	1294	1371

VERT.	93.0	99.0	105.0	111.0	117.0	123.0	129.0	135.0	141.0
-45.0	366	92	0	0	0	0	0	0	0
-39.0	1097	1017	1040	978	615	0	0	0	0
-33.0	1371	1479	1415	1466	1537	762	235	0	0
-27.0	1828	1848	1890	1955	1644	1523	353	0	0
-21.0	2377	2403	2363	2542	2356	1959	940	260	0
-15.0	3656	3604	3497	3519	3074	2720	1645	1290	0
-9.0	6309	5915	6333	5376	5020	4026	2703	2455	145
-3.0	14260	13216	12476	10954	8914	6311	6463	3620	145
3.0	14260	13956	13800	12414	10143	7073	4465	3100	0
9.0	6764	6747	5616	5665	5020	4135	3290	2325	0
15.0	3748	3604	3592	3617	3279	2938	2115	130	0
21.0	2468	2403	2457	2542	2459	2067	705	0	0
27.0	1828	1756	1890	1857	1644	1088	119	0	0
33.0	1371	1294	1323	1466	1025	219	0	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: H500J55LA1 TABLE NO. 66

HORZ. ANGLES (H 1- 15)

VERT.	39.0	45.0	51.0	57.0	63.0	69.0	75.0	81.0	87.0
39.0	0	0	0	0	102	587	651	739	623

VERT.	93.0	99.0	105.0	111.0	117.0	123.0	129.0	135.0	141.0
39.0	623	739	651	587	102	0	0	0	0

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] TABLE NO. 67

HORZ. ANGLES (V [illegible])

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
0.0		889	1135	1457	1715	2061	2355	2372	1716	490
	225	201	225	497	1718	2372	2355	2061	1715	1457
	1135	889	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	889	1135
5.0		1580	2067	2480	2892	3240	3497	3135	1664	692
	427	397	427	692	1664	3135	3497	3240	2892	2480
	2067	1580	1171	916	0	0	0	0	0	0
	0	0	0	0	0	0	916	1171	1580	2067
10.0		2811	3271	3723	4343	4768	4470	3173	1755	1008
	705	681	705	1008	1755	3173	4470	4768	4343	3723
	3271	2811	2319	1852	1444	1048	725	449	190	56
	56	190	449	725	1048	1444	1852	2319	2811	3271
15.0		4293	4801	5244	5432	5455	4653	3043	2035	1328
	932	870	932	1328	2035	3043	4653	5455	5432	5244
	4801	4293	3706	3282	2859	2369	1844	1292	585	96
	96	585	1292	1844	2369	2869	3282	3706	4293	4801
20.0		5711	6227	6409	6030	5308	4267	3128	2316	1660
	1144	1159	1144	1660	2318	3128	4267	5308	6030	6409
	6227	5771	5269	4855	4373	3725	2955	1927	636	270
	270	636	1927	2966	3726	4373	4855	5269	5771	6227
25.0		6387	6369	6199	5777	5192	4267	3258	2531	1928
	1387	1271	1387	1928	2531	3258	4267	5192	5777	6199
	6369	6397	6192	5738	5111	4227	3000	1710	872	587
	587	872	1710	3000	4227	5111	5738	5192	6397	6360
35.0		5733	5683	5544	5355	4837	3999	3331	2925	2375
	1917	1339	1917	2375	2925	3331	3999	4837	5355	5544
	5683	5733	5563	5159	4526	3611	2715	2159	1441	1160
	1160	1441	2059	2715	3611	4526	5159	5563	5733	5683
45.0		5327	5319	5168	4753	4163	3779	3575	3290	2855
	2566	2511	2564	2455	3290	3575	3779	4163	4759	5168
	5319	5327	5065	4543	3442	3372	2853	2455	1966	1562
	1562	1966	2455	2853	3372	3442	4543	5065	5327	5319

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE [illegible] TABLE NO. 57

HORZ. ANGLES (V 3, 13)

VERT.										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	90.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0
	175.0	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0
	275.0	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0
55.0		4157	4132	4102	4060	4076	3940	3767	3561	3295
	3115	3074	3115	3295	3561	3767	3940	4076	4060	4102
	4132	4157	4043	3849	3634	3380	3119	2731	2323	2046
	2046	2323	2731	3119	3380	3634	3849	4043	4157	4132
65.0		4111	4122	4103	4045	3937	3915	3937	3822	3631
	3508	3507	3504	3631	3822	3937	3915	3937	4045	4103
	4122	4111	3998	3839	3634	3429	3236	2966	2764	2644
	2644	2764	2966	3236	3429	3634	3839	3998	4111	4122
75.0		3997	3988	3967	3952	3942	3843	3812	3743	3690
	3644	3674	3644	3690	3743	3812	3843	3942	3952	3960
	3988	3997	3747	3700	3625	3520	3347	3256	3143	3120
	3120	3133	3256	3397	3520	3625	3700	3747	3897	3988
85.0		3624	3637	3641	3650	3654	3633	3646	3645	3642
	3643	3653	3644	3642	3646	3648	3653	3654	3650	3641
	3637	3624	3612	3601	3582	3558	3541	3524	3507	3482
	3482	3507	3524	3541	3558	3582	3601	3612	3624	3637
90.0		3557	3557	3557	3557	3557	3557	3557	3557	3557
	3557	3557	3557	3557	3557	3557	3557	3557	3557	3557
	3557	3557	3557	3557	3557	3557	3557	3557	3557	3557
	3557	3557	3557	3557	3557	3557	3557	3557	3557	3557

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - LUMINAIRE CODE: VIS[illegible]302 TABLE NO. 48

HORZ. ANGLES (V 3- 13)										
		-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
	85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
	185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
	285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
VERT.										
-40.0		78	78	7[illegible]	54	43	35	25	19	17
	17	17	17	19	25	35	43	54	70	78
	79	66	47	35	25	17	10	8	8	9
	9	10	17	25	35	47	55	78	78	
-20.0		130	132	136	134	126	124	120	116	107
	101	101	107	116	120	124	126	134	135	132
	130	130	122	111	95	87	75	56	39	39
	66	75	87	95	111	122	130	130	132	
-5.0		39	41	41	39	39	54	65	103	103
	101	101	103	103	65	54	39	39	41	41
	39	39	41	47	55	64	[illegible]	99	111	111
	99	89	64	58	47	41	39	39	41	
5.0		175	136	210	238	282	359	520	606	499
	271	271	499	506	524	359	250	238	210	186
	176	187	199	205	210	274	314	282	161	161
	282	319	274	210	215	199	187	175	186	
15.0		3202	3250	3499	3653	4325	4440	3991	2579	1353
	1069	1069	1353	2579	3991	4425	4325	3553	3495	3250
	3202	3269	3339	3537	3652	3403	2785	1069	804	804
	1069	2785	3403	3352	3537	3359	3269	3202	3240	
25.0		7653	7777	7655	7798	7117	4634	3552	3177	2640
	2300	2300	2640	3177	3852	4634	7117	7798	7655	7777
	7653	7529	7251	6529	4319	3424	2713	2238	1959	1959
	2238	2713	3424	4319	6529	7251	7529	7653	7777	
35.0		6495	6531	6488	6240	5673	4874	4600	4276	3577
	3309	3399	3677	4276	4600	4874	5673	6240	6485	6531
	6495	6363	5031	5384	4518	4218	3875	3240	3025	3025
	3280	3873	4218	4518	5384	5061	6353	6495	6531	
45.0		6116	6156	6148	6072	5930	5721	5456	5152	4603
	4335	4335	4603	5152	5456	5721	5930	6072	6148	6165
	6116	6013	5657	5645	5375	5112	4792	4224	3957	3957
	4224	4792	5112	5375	5645	5657	6013	6116	6156	

CANDLEPOWER TABLE PRINTOUT

CANDLEPOWER TABLE - [illegible] TABLE NO. 64

HORZ. ANGLES (V 38 (3))

VERT.									
	-5.0	5.0	15.0	25.0	35.0	45.0	55.0	65.0	75.0
85.0	95.0	105.0	115.0	125.0	135.0	145.0	155.0	165.0	175.0
185.0	195.0	205.0	215.0	225.0	235.0	245.0	255.0	265.0	275.0
285.0	295.0	305.0	315.0	325.0	335.0	345.0	355.0	365.0	
55.0	6386	6425	6415	6353	6235	6104	5885	5535	5214
4904	4394	5214	5635	5345	6104	6235	5353	6415	6425
6386	6295	6160	5975	5736	5457	5214	4724	4608	4505
4724	5214	5457	5736	5975	6160	6295	6386	6425	
65.0	6847	6805	6851	6823	6742	6622	6444	6196	5941
5778	5778	5941	6196	6444	6622	6742	6823	6851	6805
5847	5783	6678	6531	6349	6130	5885	5595	5427	5427
5595	5896	6130	6349	6531	6678	6783	6847	6865	
75.0	6564	6571	6559	6533	6475	6353	6243	6106	6009
5941	5941	6009	6106	3253	6303	6475	6533	6558	6571
6564	6513	6440	6335	6207	6054	5920	5813	5730	5730
5813	5920	6054	6207	6335	6440	6513	6564	6571	
85.0	5927	5929	5932	5934	5922	5905	5893	5874	5864
5850	5850	5864	5879	5893	5908	5922	5934	5932	5929
5927	5925	5922	5873	5851	5828	5805	5783	5761	5761
5783	5805	5828	5851	5873	5922	5925	5927	5930	
90.0	5903	5903	5903	5903	5903	5903	5903	5903	5903
5903	5903	5903	5903	5903	5903	5903	5903	5903	5903
5903	5903	5903	5903	5903	5903	5903	5903	5903	5903
5903	5903	5903	5903	5903	5903	5903	5903	5903	

END OF RUN 78/02/09 09.11.12

B142

```
FULL  DAYFILE.  79/02/0-. 09.11.13.08.56.41* PAGE    1

08.56.41.  T132 .
08.56.42. CCOUNT. 0019].
08.56.42.COMMENT.712021201
08.56.42.COMMENT.CHARGE THI  JOB TO  PRINTING INK
08.56.42.Y
08.56.42.ATTACH(TAPE1=CANDLER/MAR)
08.56.42.GET(TAPE2=LIGHTIT)
08.56.43.REWIND(TAPE1.TAPE2)
08.56.43.PURGE(LIGHTIT)
08.56.44.COPYSBF(TAPE2.OUTPUT)
08.56.44. END OF INFORMATION ENCOUNTERED.
08.56.44.REWIND(TAPE2)
08.56.44.GET(LIGHTIO)
08.56.47.RFL(70000)
09.02.44.LIGHTIO(TAPE2)
09.02.46.  CM LWA+1 = 52248  LOADER USED  66610R
09.11.12.     STOP
09.11.12.     12.7 1 CP SECONDS EXECUTION TIME
09.11.12.RFL(10000)
09.11.13.RETURN(TAPE1.TAPE2.LIGHTIO)
09.11.13.CTIME     14.051 SECS.
09.11.13.DAYFILE.
```

B143

```
.L  DAYFILE.  7?/02/0?. 09.11.14.?0?.??.41? PAGE    1

   .41. [illegible]T13? .
 .5?.42.ACCOUNT.?C?[illegible].
 08.56.42.COMMENT.7120212?1?
 08.56.42.COMMENT.[illegible] TH[illegible] [illegible] ??? ???[illegible]
 08.56.42.?
 08.56.42.ATTACH(TAPE1=CANDL??/ME?)
 08.56.42.GET(TAPE2=LIGHTIT)
 08.56.43.REWIND(TAPE1.TAPE2)
 08.56.43.PURGE(LIGHTIT)
 08.56.44.COPYSHF(TAPE2.OUTPUT)
 08.56.44. END OF INFORMATION ENCOUNTERED.
 08.56.44.RENAME(TAPE2)
 08.56.44.GET(LIGHT10)
 08.56.47.RFL(70000)
 09.02.44.LIGHT10(TAPE2)
 09.02.45.  CM [illegible] = ?2??? LOADER USED  ??????
 09.11.12.      STOP
 09.11.12.      12.701 CP SECONDS EXECUTION TIME
 09.11.12.RFL(10000)
 09.11.13.RETURN(TAPE1.TAPE2.LIGHT10)
 09.11.13.CTIME      14.051 SECS.
 09.11.13.DAYFILE.
 09.11.14. USER DAYFILE DUMPED.
 09.11.14.DAYFILE.
```

B144

APPENDIX C

COMPUTER PRINTOUTS OF ILLUMINATION GRIDS FOR SELECTED PERIMETER LIGHTING ARRANGEMENTS

APPENDIX C

COMPUTER PRINTOUTS OF ILLUMINATION GRID FOR SELECTED PERIMETER LIGHTING ARRANGEMENTS

(See Par. 7-1 of Report)

INDEX

COMPUTER TRIAL NO.	APPLICABLE PL SCHEME NUMBERS	LUMINAIRE CONFIGURATION	POLE SPACING (FEET)	SHEET
DES6	2	1x500Q-F	50	1
DES42	5	3x500Q-F	70	8
DES50	1	2x500Q-F	60	12
DES53	15	3x180LPS-R	120	19
DES55	4	1x1500Q-F	45	23
DES55A	26	1x1500Q-F	50	27
DES59	3, 19	2x1500Q-F	120	31
DES76F	12	1x180LPS-F	60	122
DES80E	28	1x180LPS-R	60	126
DES80F	16	1x180LPS-R	70	133
DES81	17	2x180LPS-R	100	140
DES91E	6	1x250HPS-R	40	180
DES93	11	2x90LPS-F	100	199
DES94	14	2x180LPS-F	120	206
DES95	13	2x180LPS-F	120	213
DES96A	19	1x400HPS-F	80	220
DES96B	27	1x400HPS-F	80	224
DES97	7	1x250HPS-F	60	228
DES98	8, 18	2x250HPS-F	120	232

NOTE: Pages 38-114, 147-149 and 184-198 are missing due to deletion of area lighting printouts

ABBREVIATIONS

2x500	=	two 500 watt luminaires
Q	=	quartz iodine
LPS	=	low pressure sodium
HPS	=	high pressure sodium
F	=	floodlight unit
R	=	roadway type of luminaire
PL	=	perimeter lighting

10	I	I				
30	TEST 6 1X500W + 1X1500W Q 50 FT SPACING 30 FT MOUNTING					
40	Q1500WL2GE	0.95	0.95	1.00		
40	Q500MLGE	0.95	0.85	1.00		
40	9999999999					
60	Q1500WL2GE	0.00	0.00	30.00	135.00	50.00
60	Q1500WL2GE	50.00	0.00	30.00	135.00	50.00
60	Q1500WL2GE	100.00	0.00	30.00	135.00	50.00
60	Q500MLGE	0.00	0.00	30.00	90.00	30.00
60	Q500MLGE	50.00	0.00	30.00	90.00	30.00
60	Q500MLGE	100.00	0.00	30.00	90.00	30.00
60	9999999999					
70	50.00	22.50	0.00	0.00	0.00	
80	10.00	5.00	13	11	V	270.00
70	50.00	22.50	3.00	0.00	0.00	
80	10.00	5.00	13	11	V	270.00
70	50.00	22.50	9.00	0.00	0.00	
80	10.00	5.01	13	11	V	270.00
80	9999999999					

SHT 1

TEST GRID 1 COORDINATES OF CENTER X 50.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 95.00	X 105.00	X 115.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y	50.00	1.2941	.6932	.1853	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	45.00	3.0651	1.3339	.1693	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	40.00	8.4551	3.0157	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	35.00	14.6259	4.2456	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	30.00	10.0951	2.9062	.4086	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	25.00	3.8545	1.6968	.4153	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	20.00	3.3163	2.1537	.3667	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	15.00	8.9645	8.9645	.2242	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	10.00	.4700	.4700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	5.00	.1059	.1059	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z

2

TEST GRID 1 COORDINATES OF CENTER X 50.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X -5.00	X 5.00	X 15.00	X 25.00	X 35.00	X 45.00	X 55.00	X 65.00	X 75.00	X 85.00	
Y	50.00	1.8719	1.5097	1.1996	1.2320	1.3801	1.8719	1.5097	1.1996	1.2320	1.3801	50.00 Y
Z	0.00											0.00 Z
Y	45.00	3.6672	2.2127	1.4240	1.8345	2.6747	3.6672	2.2127	1.4240	1.8345	2.4941	45.00 Y
Z	0.00											0.00 Z
Y	40.00	9.0393	3.9471	1.5025	2.9635	7.5911	9.0393	3.9471	1.5025	2.9635	7.2303	40.00 Y
Z	0.00											0.00 Z
Y	35.00	15.1714	5.2214	2.0969	7.4031	18.0963	15.1714	5.2214	2.0969	7.4031	17.7658	35.00 Y
Z	0.00											0.00 Z
Y	30.00	10.5839	3.8734	3.6000	12.8063	22.3449	10.5839	3.8734	3.6000	12.8063	22.0543	30.00 Y
Z	0.00											0.00 Z
Y	25.00	4.2686	2.7159	5.7032	16.7000	11.3202	4.2686	2.7159	5.7032	16.5482	11.0781	25.00 Y
Z	0.00											0.00 Z
Y	20.00	3.6569	3.1491	8.0263	13.3127	4.0154	3.6569	3.1491	8.0263	13.1928	3.8247	20.00 Y
Z	0.00											0.00 Z
Y	15.00	9.2206	9.7959	7.8381	6.4846	2.4606	9.2206	9.7959	7.8381	6.3977	2.3229	15.00 Y
Z	0.00											0.00 Z
Y	10.00	.6303	1.1524	4.9490	2.0175	1.2458	.6303	1.1524	4.9490	1.9632	1.1601	10.00 Y
Z	0.00											0.00 Z
Y	5.00	.1775	.4465	2.0894	.5876	.0383	.1775	.4465	2.0894	.5628	0.0000	5.00 Y
Z	0.00											0.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.0000	.00 Y
Z	0.00											0.00 Z

TEST GRID 2 COORDINATES OF CENTER X 50.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X -5.00	X 5.00	X 15.00	X 25.00	X 35.00	X 45.00	X 55.00	X 65.00	X 75.00	X 85.00	
Y	50.00	.9559	1.3379	1.1719	1.0961	1.1252	.9559	1.3379	1.1719	1.0961	1.1252	50.00 Y
Z	3.00											3.00 Z
Y	45.00	2.1911	1.6594	1.3377	1.4522	1.6537	2.1911	1.6594	1.3377	1.4522	1.6537	45.00 Y
Z	3.00											3.00 Z
Y	40.00	4.9099	2.5742	1.3787	2.0455	3.1805	4.9099	2.5742	1.3787	2.0455	3.1805	40.00 Y
Z	3.00											3.00 Z
Y	35.00	13.6375	4.7722	1.5877	3.4007	10.0293	13.6375	4.7722	1.5877	3.4007	10.0293	35.00 Y
Z	3.00											3.00 Z
Y	30.00	21.0365	6.0999	1.9852	8.0488	25.0273	21.0365	6.0999	1.9852	8.0488	24.7464	30.00 Y
Z	3.00											3.00 Z
Y	25.00	8.7671	3.1786	2.8798	14.0549	24.5576	8.7671	3.1786	2.8798	14.0549	24.3210	25.00 Y
Z	3.00											3.00 Z
Y	20.00	4.0604	2.5715	4.3712	18.0338	8.7235	4.0604	2.5715	4.3712	18.0338	8.5360	20.00 Y
Z	3.00											3.00 Z
Y	15.00	11.5717	11.8881	4.5917	14.3227	3.6500	11.5717	11.8881	4.5917	14.3227	3.5136	15.00 Y
Z	3.00											3.00 Z
Y	10.00	.9049	1.1474	3.6993	5.4991	1.7351	.9049	1.1474	3.6993	5.4991	1.6498	10.00 Y
Z	3.00											3.00 Z
Y	5.00	.2070	.3230	1.8729	1.4644	.0385	.2070	.3230	1.8729	1.4644	0.0000	5.00 Y
Z	3.00											3.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.0000	.00 Y
Z	3.00											3.00 Z

4

TEST GRID 2 COORDINATES OF CENTER X 50.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 95.00	X 105.00	X 115.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y	50.00	.9559	.5607	.1816	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	45.00	1.6236	.8080	.1614	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	40.00	4.3525	1.6420	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	35.00	13.1105	3.8573	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											[illegible] Z
Y	30.00	20.5608	5.2444	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	25.00	8.3606	2.3718	.4507	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	20.00	3.7391	1.8718	.4260	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	15.00	11.3369	11.3369	.2934	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	10.00	.7585	.7585	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	5.00	.1426	.1426	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z

TEST GRID 3 COORDINATES OF CENTER X 50.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X -5.00	X 5.00	X 15.00	X 25.00	X 35.00	X 45.00	X 55.00	X 65.00	X 75.00	X 85.00	
Y 50.00 Z 9.00	.8752	.5318	.1487	1.0190	1.0301	.8752	.5318	.1487	1.0190	1.0301	50.00 Y 9.00 Z
Y 45.00 Z 9.00	1.0961	.6234	.1722	1.2747	1.3041	1.0961	.6234	.1722	1.2747	1.3041	45.00 Y 9.00 Z
Y 40.00 Z 9.00	1.4973	.7689	1.2490	1.6152	1.6903	1.4973	.7689	1.2490	1.6152	1.6903	40.00 Y 9.00 Z
Y 35.00 Z 9.00	2.7859	1.1136	1.4074	2.0482	2.6218	2.7859	1.1136	1.4074	2.0482	2.6218	35.00 Y 9.00 Z
Y 30.00 Z 9.00	10.2539	3.2884	1.5301	2.7324	5.4413	10.2539	3.2884	1.5301	2.7324	5.4413	30.00 Y 9.00 Z
Y 25.00 Z 9.00	32.0801	5.9305	1.4630	3.8510	20.5883	32.0801	5.9305	1.4630	3.8510	20.5883	25.00 Y 9.00 Z
Y 20.00 Z 9.00	19.0308	4.0475	1.3510	6.7817	38.5915	19.0308	4.0475	1.3510	6.7817	38.5915	20.00 Y 9.00 Z
Y 15.00 Z 9.00	6.1601	2.8112	1.5279	12.3530	22.8604	6.1601	2.8112	1.5279	12.3530	22.8604	15.00 Y 9.00 Z
Y 10.00 Z 9.00	13.4190	13.5498	.8123	13.3402	5.8398	13.4190	13.5498	.8123	13.3402	5.8398	10.00 Y 9.00 Z
Y 5.00 Z 9.00	.3815	.4380	.3980	6.4160	1.4096	.3815	.4380	.3980	6.4160	1.4096	5.00 Y 9.00 Z
Y -.00 Z 9.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 9.00 Z

6

TEST GRID 3 COORDINATES OF CENTER X 50.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 95.00	X 105.00	X 115.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y	50.00	.8752	.5318	.1487	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	45.00	1.0961	.6234	.1722	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	40.00	1.4973	.7489	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	35.00	2.7859	1.1136	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	30.00	10.2539	2.5012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.
Z	9.00											0.[illegible] Z
Y	25.00	32.0801	5.2223	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	20.00	19.0308	3.4607	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	15.00	6.1601	2.3766	.4043	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	10.00	13.2744	13.2744	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	5.00	.3162	.3162	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z

00100 0000						
00110	TEST42 3X500 W Q 70 FT SPACING 15 FT MTG H100 V93					
00120	Q500WMGE	0.95	0.85	1.00		
00130	9999999999					
00140	Q500WMGE	0.00	0.00	15.00	135.00	65.00
00150	Q500WMGE	70.00	0.00	15.00	135.00	65.00
00160	Q500WMGE	140.00	0.00	15.00	135.00	65.00
00170	Q500WMGE	210.00	0.00	15.00	135.00	65.00
00180	Q500WMGE	0.00	0.00	15.00	90.00	65.00
00190	Q500WMGE	70.00	0.00	15.00	90.00	65.00
00200	Q500WMGE	140.00	0.00	15.00	90.00	65.00
00210	Q500WMGE	210.00	0.00	15.00	90.00	65.00
00220	Q500WMGE	0.00	0.00	15.00	45.00	65.00
00230	Q500WMGE	70.00	0.00	15.00	45.00	65.00
00240	Q500WMGE	140.00	0.00	15.00	45.00	65.00
00250	Q500WMGE	210.00	0.00	15.00	45.00	65.00
00260	9999999999					
00270	105.00	22.50	0.00	0.00	0.00	
00280	10.00	5.00	10	11	V	270.00
00290	105.00	22.50	3.00	0.00	0.00	
00300	10.00	5.00	10	11	V	270.00
00310	105.00	22.50	9.00	0.00	0.00	
00320	10.00	5.00	10	11	V	270.00
00330	9999999999					

TEST GRID 1 COORDINATES OF CENTER X 105.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 65.00	X 75.00	X 85.00	X 95.00	X 105.00	X 115.00	X 125.00	X 135.00	X 145.00	X 155.00	
Y	50.00	3.0027	2.9994	2.8863	2.6933	2.6184	2.6933	2.8854	3.0102	2.9918	2.8627	50.00 Y
Z	0.00											0.00 Z
Y	45.00	3.6351	3.6210	3.3691	3.0195	2.8629	3.0195	3.3680	3.6419	3.6142	3.3479	45.00 Y
Z	0.00											0.00 Z
Y	40.00	4.3638	4.3499	3.9746	3.4087	3.0880	3.4077	3.9746	4.3699	4.3638	3.9558	40.00 Y
Z	0.00											0.00 Z
Y	35.00	5.3233	5.3283	4.7703	3.6983	3.1796	3.6983	4.7703	5.3283	5.3233	4.7544	35.00 Y
Z	0.00											0.00 Z
Y	30.00	6.5298	6.5339	5.5057	3.9944	3.2378	3.9944	5.5057	6.5339	6.5298	5.4929	3 Y
Z	0.00											0.v0 Z
Y	25.00	7.8387	7.8418	6.2864	3.8261	2.9532	3.8289	6.2864	7.8418	7.8387	6.2766	25.00 Y
Z	0.00											0.00 Z
Y	20.00	8.0276	8.0298	6.2722	3.4555	2.5866	3.4634	6.2722	8.0298	8.0276	6.2651	20.00 Y
Z	0.00											0.00 Z
Y	15.00	7.2382	7.2396	4.9958	2.6985	1.8587	2.6985	4.9914	7.2396	7.2382	4.9912	15.00 Y
Z	0.00											0.00 Z
Y	10.00	5.0858	5.0866	3.0790	1.6118	1.0507	1.6118	3.0790	5.0866	5.0858	3.0764	10.00 Y
Z	0.00											0.00 Z
Y	5.00	1.7498	1.7588	1.0414	.5378	.3595	.5378	1.0414	1.7581	1.7584	1.0404	5.00 Y
Z	0.00											0.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y
Z	0.00											0.00 Z

TEST GRID 2 COORDINATES OF CENTER X 105.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 65.00	X 75.00	X 85.00	X 95.00	X 105.00	X 115.00	X 125.00	X 135.00	X 145.00	X 155.00	
Y 50.00	Z 3.00	2.7732	2.7790	2.6582	2.4972	2.4385	2.4972	2.6560	2.7803	2.7719	2.6361	50.00 Y 3.00 Z
Y 45.00	Z 3.00	3.3685	3.3672	3.1144	2.7815	2.6478	2.7810	3.1109	3.3748	3.3609	3.0945	45.00 Y 3.00 Z
Y 40.00	Z 3.03	4.0692	4.0749	3.6963	3.1375	2.8500	3.1358	3.6963	4.0749	4.0692	3.6786	40.00 Y 3.00 Z
Y 35.00	Z 3.00	5.3346	5.3394	4.5369	3.4147	2.9412	3.4147	4.5369	5.3394	5.3346	4.5218	35.00 Y 3.00 Z
Y 30.00	Z 3.00	7.2265	7.2304	5.6812	3.7253	2.9945	3.7253	5.6812	7.2304	7.2265	5.6691	30.00 Y 3.00 Z
Y 25.00	Z 3.00	9.4102	9.4132	6.9582	3.8071	2.7133	3.8107	6.9582	9.4132	9.4102	6.9489	25.00 Y 3.00 Z
Y 20.00	Z 3.00	11.9386	11.9408	7.6690	3.6616	2.3936	3.6973	7.6690	11.9408	11.9386	7.6621	20.00 Y 3.00 Z
Y 15.00	Z 3.00	12.0502	12.0517	7.2213	2.9447	1.7717	2.9447	7.2160	12.0517	12.0502	7.2168	15.00 Y 3.00 Z
Y 10.00	Z 3.00	9.7203	9.7211	4.8639	1.7787	1.0388	1.7787	4.8639	9.7211	9.7203	4.8614	10.00 Y 3.00 Z
Y 5.00	Z 3.00	3.8423	3.8400	1.7607	.6255	.3616	.6255	1.7607	3.8426	3.8597	1.7598	5.00 Y 3.00 Z
Y -.00	Z 3.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 3.00 Z

TEST42 3X500 W Q 70 FT SPACING 15 FT MTG H100 V93

TEST GRID 3 COORDINATES OF CENTER X 105.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 65.00	X 75.00	X 85.00	X 95.00	X 105.00	X 115.00	X 125.00	X 135.00	X 145.00	X 155.00	
Y Z	50.00 9.00	2.2980	2.2838	2.2098	2.0712	2.0397	2.0712	2.2051	2.3044	2.2773	2.1899	50.00 Y 9.00 Z
Y Z	45.00 9.00	2.7584	2.7398	2.5524	2.2975	2.1916	2.2958	2.5438	2.7641	2.7341	2.5344	45.00 Y 9.00 Z
Y Z	40.00 9.00	3.2678	3.2731	2.9859	2.5632	2.3260	2.5558	2.9859	3.2731	3.2578	2.9698	40.00 Y 9.00 Z
Y Z	35.00 9.00	4.2452	4.2496	3.6371	2.7526	2.3723	2.7526	3.6371	4.2496	4.2452	3.6235	35.00 Y 9.00 Z
Y Z	30.00 9.00	5.8324	5.8360	4.5345	2.9808	2.3884	2.9808	4.5345	5.8360	5.8324	4.5235	30. [illegible] 9.[illegible] Z
Y Z	25.00 9.00	8.6225	8.6252	5.7641	3.0402	2.1297	3.0425	5.7641	8.6252	8.6225	5.7556	25.00 Y 9.00 Z
Y Z	20.00 9.00	14.1143	14.1163	7.2253	2.9008	1.8779	2.9130	7.2253	14.1163	14.1143	7.2191	20.00 Y 9.00 Z
Y Z	15.00 9.00	25.2640	25.2653	8.3460	2.3994	1.4121	2.3994	8.3510	25.2653	25.2640	8.3419	15.00 Y 9.00 Z
Y Z	10.00 9.00	40.7163	40.7170	7.6472	1.5665	.8517	1.5665	7.6472	40.7170	40.7163	7.6450	10.00 Y 9.00 Z
Y Z	5.00 9.00	29.7602	29.7794	3.6332	.5896	.3074	.5896	3.6332	29.7605	29.7791	3.6323	5.00 Y 9.00 Z
Y Z	-.00 9.00	.0000	-.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 9.00 Z

10						
30	TEST 50 2X500 QUARTZ H100 V93 60 FT SPACING 15 FT MOUNTING					
40	Q500WMGE	0.95	0.85	1.00		
40	9999999999					
60	Q500WMGE	0.00	0.00	15.00	135.00	70.00
60	Q500WMGE	60.00	0.00	15.00	135.00	70.00
60	Q500WMGE	120.00	0.00	15.00	135.00	70.00
60	Q500WMGE	0.00	0.00	15.00	60.00	70.00
60	Q500WMGE	60.00	0.00	15.00	60.00	70.00
60	Q500WMGE	120.00	0.00	15.00	60.00	70.00
60	9999999999					
70	60.00	22.50	0.00	0.00	0.00	
80	10.00	5.00	13	11	V	270.00
70	60.00	22.50	3.00	0.00	0.00	
80	10.00	5.00	13	11	V	270.00
70	60.00	22.50	9.00	0.00	0.00	
80	10.00	5.00	13	11	V	270.00
80	9999999999					

TEST 50 2X500 QUARTZ M100 V93 60 FT SPACING 15 FT MOUNTING PAGE

TEST GRID 1 COORDINATES OF CENTER X 60.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 5.00	X 15.00	X 25.00	X 35.00	X 45.00	X 55.00	X 65.00	X 75.00	X 85.00	X 95.00	
Y 50.00 Z 0.00	2.1219	2.6337	2.7471	2.4954	2.2845	2.1794	2.3357	2.7174	2.7282	2.3772	50.00 Y 0.00 Z
Y 45.00 Z 0.00	2.6421	3.0650	3.1718	2.8955	2.5210	2.4035	2.6412	3.1341	3.1499	2.7818	45.00 Y 0.00 Z
Y 40.00 Z 0.00	2.7081	3.5388	3.5818	3.3191	2.8027	2.6749	2.8855	3.5994	3.5560	3.2128	40.00 Y 0.00 Z
Y 35.00 Z 0.00	3.2535	4.0724	3.8795	3.6005	3.0510	3.0134	3.4032	4.1174	3.8520	3.5034	35.00 Y 0.00 Z
Y 30.00 Z 0.00	3.7344	4.6620	4.0518	3.7814	3.6376	3.3091	3.8458	4.6909	4.0227	3.6961	30.. Y 0.00 Z
Y 25.00 Z 0.00	4.0657	4.7148	3.9022	3.7839	4.0139	3.5066	4.1399	4.7282	3.8731	3.7133	25.00 Y 0.00 Z
Y 20.00 Z 0.00	4.3114	4.3563	3.2398	3.4085	4.0638	3.4966	4.3498	4.3561	3.2157	3.3558	20.00 Y 0.00 Z
Y 15.00 Z 0.00	4.0753	3.4103	2.1830	2.5206	3.6952	3.2483	4.0914	3.4072	2.1647	2.4844	15.00 Y 0.00 Z
Y 10.00 Z 0.00	2.8387	1.7667	1.0672	1.3324	2.5093	2.3256	2.8412	1.7544	1.0524	1.3100	10.00 Y 0.00 Z
Y 5.00 Z 0.00	.9777	.4563	.2772	.4320	.8444	1.0633	.9747	.4502	.2715	.4236	5.00 Y 0.00 Z
Y -.00 Z 0.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 0.00 Z

TEST GRID 1 COORDINATES OF CENTER X 60.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 105.00	X 115.00	X 125.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 50.00 Z 0.00	2.0516	1.8037	1.7656	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 45.00 Z 0.00	2.2969	2.0282	2.0508	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 40.00 Z 0.00	2.5953	2.3154	2.2953	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 35.00 Z 0.00	2.8655	2.6889	2.8303	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 30.00 Z 0.00	3.4781	3.0304	3.3440	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 25.00 Z 0.00	3.8854	3.2801	3.7256	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 20.00 Z 0.00	3.9685	3.3266	4.0330	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 15.00 Z 0.00	3.6321	3.1344	3.8774	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 10.00 Z 0.00	2.4737	2.2645	2.7260	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 5.00 Z 0.00	.8313	1.0412	.9346	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y .00 Z 0.00	.0000	.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

TEST GRID 2 COORDINATES OF CENTER X 60.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 5.00	X 15.00	X 25.00	X 35.00	X 45.00	X 55.00	X 65.00	X 75.00	X 95.00	X 95.00	
Y 50.00	Z 3.00	2.0237	2.4531	2.5584	2.3278	2.1457	2.0792	2.2221	2.5309	2.5407	2.2180	50.00 Y 3.00 Z
Y 45.00	Z 3.00	2.4104	2.9858	2.9764	2.7093	2.4374	2.3796	2.5955	3.0345	2.9558	2.6038	45.00 Y 3.00 Z
Y 40.00	Z 3.00	2.7792	3.6017	3.4680	3.1901	2.8245	2.7553	2.9445	3.6576	3.4445	3.0911	40.00 Y 3.00 Z
Y 35.00	Z 3.00	3.4028	4.2505	3.9357	3.6438	3.1321	3.1773	3.5396	4.2919	3.9098	3.5534	35.00 Y 3.00 Z
Y 30.00	Z 3.00	4.3079	4.9891	4.2393	3.9706	3.8439	3.7627	4.4122	5.0159	4.2119	3.8909	30.00 Y 3 Z
Y 25.00	Z 3.00	5.4946	5.6433	4.1658	4.0765	4.8534	4.4847	5.5648	5.6761	4.1386	4.0105	25.00 Y 3.00 Z
Y 20.00	Z 3.00	6.3289	5.8917	3.5742	3.8468	5.5950	4.9805	6.3662	5.8938	3.5517	3.7972	20.00 Y 3.00 Z
Y 15.00	Z 3.00	6.8602	4.8984	2.5328	3.0749	5.3900	5.2617	6.8763	4.8957	2.5156	3.0410	15.00 Y 3.00 Z
Y 10.00	Z 3.00	5.5821	2.7740	1.2632	1.7647	3.9981	4.4753	5.5650	2.7641	1.2490	1.7434	10.00 Y 3.00 Z
Y 5.00	Z 3.00	2.2175	.6813	.3166	.5685	1.4148	2.4476	2.2147	.6774	.3111	.5604	5.00 Y 3.00 Z
Y -.00	Z 3.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 3.00 Z

TEST 50 2X500 QUARTZ H100 V93 60 FT SPACING 15 FT MOUNTING   PAGE 8

TEST GRID 2   COORDINATES OF CENTER X   60.00, Y   22.50, Z   3.00
ANGLES OF ORIENTATION HORZ   0.00, VERT   0.00

		X	X	X	X	X	X	X	X	X	X	
		105.00	115.00	125.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Y 50.00	Z 3.00	1.9304	1.7317	1.6926	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 45.00	Z 3.00	2.2306	2.0334	2.0478	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 40.00	Z 3.00	2.6328	2.4235	2.3983	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 35.00	Z 3.00	2.9597	2.8765	3.0132	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 30.00	Z 3.00	3.6952	3.5030	3.9463	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 25.00	Z 3.00	4.7333	4.2731	5.1778	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 20.00	Z 3.00	5.5056	4.8211	6.0693	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 15.00	Z 3.00	5.3306	5.1545	6.6749	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 10.00	Z 3.00	3.9643	4.4176	5.4762	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 5.00	Z 3.00	1.4022	2.4267	2.1763	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y .00	Z 3.00	.0000	.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

TEST GRID 3 COORDINATES OF CENTER X 60.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 5.00	X 15.00	X 25.00	X 35.00	X 45.00	X 55.00	X 65.00	X 75.00	X 85.00	X 95.00	
Y 50.00 Z 9.00	1.7101	2.0117	2.1115	1.9334	1.8260	1.7877	1.8817	2.0810	2.0978	1.8392	50.00 Y 9.00 Z
Y 45.00 Z 9.00	2.0215	2.3993	2.4372	2.2184	2.0502	2.0322	2.1621	2.4611	2.4212	2.1281	45.00 Y 9.00 Z
Y 40.00 Z 9.00	2.3166	2.8938	2.8227	2.5682	2.3421	2.3770	2.4607	2.9445	2.8038	2.4833	40.00 Y 9.00 Z
Y 35.00 Z 9.00	2.9925	3.5703	3.1774	2.9178	2.6630	2.8989	3.1122	3.6082	3.1557	2.8394	35.00 Y 9.00 Z
Y 30.00 Z 9.00	4.1106	4.5075	3.4731	3.2952	3.4526	3.7375	4.2026	4.5320	3.4491	3.2250	30.00 Y 9.00 Z
Y 25.00 Z 9.00	6.1927	5.6360	3.5196	3.5575	4.7763	5.1939	6.2549	5.6476	3.4952	3.4985	25.00 Y 9.00 Z
Y 20.00 Z 9.00	10.4631	6.9509	3.1817	3.5641	5.6790	7.8591	10.4967	6.9527	3.1610	3.5192	20.00 Y 9.00 Z
Y 15.00 Z 9.00	17.7986	7.5829	2.4126	3.0230	8.7475	12.8624	17.8132	7.5801	2.3963	2.9918	15.00 Y 9.00 Z
Y 10.00 Z 9.00	25.7576	5.3886	1.2759	1.8616	8.3894	20.2173	25.7602	5.3793	1.2628	1.8420	10.00 Y 9.00 Z
Y 5.00 Z 9.00	17.8047	1.3708	.3201	.6607	3.6669	21.2181	17.8020	1.3672	.3150	.6533	5.00 Y 9.00 Z
Y -.00 Z 9.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0400	.0000	.00 Y 9.00 Z

TEST GRID 3 COORDINATES OF CENTER X 60.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 105.00	X 115.00	X 125.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 50.00 Z 9.00		1.6405	1.4910	1.4350	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 45.00 Z 9.00		1.8720	1.7371	1.7221	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 40.00 Z 9.00		2.1767	2.0949	2.0044	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 35.00 Z 9.00		2.5144	2.6434	2.6749	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 30.00 Z 9.00		3.3235	3.5165	3.8152	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 25.00 Z 9.00		4.6710	5.0126	5.9315	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 20.00 Z 9.00		6.5998	7.7211	10.2467	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 15.00 Z 9.00		8.6943	12.7489	17.6421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 10.00 Z 9.00		8.3589	20.1662	25.6666	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 5.00 Z 9.00		3.6555	21.1993	17.7681	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y .00 Z 9.00		.0000	.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

00100	0000					
00110	TEST 53 3X180 W LPS 120 FT SPACING 30 FT MTG					
00120	LP180WGQV	0.75	1.00	1.00		
00130	9999999999					
00140	LP180WGQV	0.00	-1.00	30.00	90.00	20.00
00150	LP180WGQV	0.00	-1.00	30.00	90.00	20.00
00160	LP180WGQV	0.00	-1.00	30.00	90.00	20.00
00170	LP180WGQV	120.00	-1.00	30.00	90.00	20.00
00180	LP180WGQV	120.00	-1.00	30.00	90.00	20.00
00190	LP180WGQV	120.00	-1.00	30.00	90.00	20.00
00200	LP180WGQV	240.00	-1.00	30.00	90.00	20.00
00210	LP180WGQV	240.00	-1.00	30.00	90.00	20.00
00220	LP180WGQV	240.00	-1.00	30.00	90.00	20.00
00230	LP180WGQV	360.00	-1.00	30.00	90.00	20.00
00240	LP180WGQV	360.00	-1.00	30.00	90.00	20.00
00250	LP180WGQV	360.00	-1.00	30.00	90.00	20.00
00260	9999999999					
00270	210.00	38.00	0.00	0.00	0.00	
00280	10.00	5.00	10	17	V	270.00
00290	210.00	38.00	3.00	0.00	0.00	
00300	10.00	5.00	10	17	V	270.00
00310	210.00	38.00	9.00	0.00	0.00	
00320	10.00	5.00	10	17	V	270.00
00330	9999999999					

TEST 53 3X180 W LPS 120 FT SPACING 30 FT MTG

TEST GRID 1 COORDINATES OF CENTER X 210.00, Y 38.00, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 170.00	X 180.00	X 190.00	X 200.00	X 210.00	X 220.00	X 230.00	X 240.00	X 250.00	X 260.00	
Y 80.50 Z 0.00	1.8258	1.8013	1.8211	1.8954	1.9990	2.1010	2.1725	2.1989	2.1740	2.1013	80.50 Y 0.00 Z
Y 75.50 Z 0.00	1.8782	1.8411	1.8702	1.9667	2.1028	2.2320	2.3233	2.3591	2.3280	2.2376	75.50 Y 0.00 Z
Y 70.50 Z 0.00	1.9285	1.8771	1.9168	2.0432	2.2132	2.3742	2.4922	2.5402	2.5014	2.3862	70.50 Y 0.00 Z
Y 65.50 Z 0.00	1.9783	1.9076	1.9631	2.1197	2.3295	2.5288	2.6816	2.7452	2.6963	2.5486	65.50 Y 0.00 Z
Y 60.50 Z 0.00	2.0262	1.9308	2.0063	2.1950	2.4472	2.6967	2.9119	3.0035	2.9324	2.7267	60.50 Y 0.00 Z
Y 55.50 Z 0.00	2.0655	1.9607	2.0403	2.2667	2.5688	2.9157	3.2032	3.3264	3.2304	2.9564	55.50 Y 0.00 Z
Y 50.50 Z 0.00	2.0929	1.9799	2.0617	2.3273	2.7110	3.1595	3.5392	3.7017	3.5746	3.2135	50.50 Y 0.00 Z
Y 45.50 Z 0.00	2.1043	1.9742	2.0682	2.3711	2.8467	3.4216	3.9199	4.1382	3.9660	3.4909	45.50 Y 0.00 Z
Y 40.50 Z 0.00	2.0833	1.9362	2.0464	2.3845	2.9616	3.6863	4.3467	4.6491	4.4058	3.7735	40.50 Y 0.00 Z
Y 35.50 Z 0.00	2.0124	1.8547	1.9748	2.3551	3.0289	3.9438	4.8501	5.2547	4.9153	4.0484	35.50 Y 0.00 Z
Y 30.50 Z 0.00	1.8867	1.7287	1.8472	2.2626	3.0328	4.1861	5.3613	5.9017	5.4283	4.3034	30.50 Y 0.00 Z
Y 25.50 Z 0.00	1.6987	1.5453	1.6586	2.0978	2.9601	4.3234	5.7040	6.2772	5.7808	4.4543	25.50 Y 0.00 Z
Y 20.50 Z 0.00	1.4489	1.2933	1.4110	1.8481	2.7488	4.2281	5.6266	6.2923	5.7105	4.3744	20.50 Y 0.00 Z

TEST 53 3X180 W LPS 120 FT SPACING 30 FT MTG PAGE 7

TEST GRID 2 COORDINATES OF CENTER X 210.00, Y 30.00, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 170.00	X 180.00	X 190.00	X 200.00	X 210.00	X 220.00	X 230.00	X 240.00	X 250.00	X 260.00	
Y	80.50	1.8593	1.8229	1.8562	1.9414	2.0536	2.1662	2.2445	2.2732	2.2459	2.1671	80.50 Y
Z	3.00											3.00 Z
Y	75.50	1.9043	1.8575	1.8964	2.0122	2.1656	2.3096	2.4106	2.4499	2.4152	2.3160	75.50 Y
Z	3.00											3.00 Z
Y	70.50	1.9487	1.8897	1.9364	2.0890	2.2860	2.4672	2.5993	2.6524	2.6085	2.4799	70.50 Y
Z	3.00											3.00 Z
Y	65.50	1.9972	1.9153	1.9812	2.1667	2.4146	2.6408	2.8141	2.8851	2.8290	2.6614	65.50 Y
Z	3.00											3.00 Z
Y	60.50	2.0437	1.9321	2.0329	2.2440	2.5441	2.8331	3.0589	3.1531	3.0807	2.8634	60 Y
	3.00											3.00 Z
Y	5.50	2.0808	1.9414	2.0544	2.3186	2.6740	3.0445	3.3423	3.4789	3.3733	3.0891	53.50 Y
Z	3.00											3.00 Z
Y	50 [illegible]	2.1047	1.9831	2.0719	2.3795	2.8148	3.3031	3.7270	3.9105	3.7674	3.3641	50.50 Y
Z	3. [illegible]											3.00 Z
Y	[illegible]	2.1179	1.9602	2.0797	2.4304	2.9679	3.6100	4.1757	4.4260	4.2286	3.6889	45.50 Y
Z	3.00											3.00 Z
Y	40.50	2.1016	1.9448	2.0618	2.4661	3.1112	3.9331	4.6944	5.0369	4.7630	4.0333	40.50 Y
Z	3.00											3.00 Z
Y	35.50	2.0443	1.8653	2.0043	2.4483	3.2091	4.2523	5.2836	5.7692	5.3703	4.3756	35.50 Y
Z	3.00											3.00 Z
Y	30.50	1.9314	1.7406	1.8916	2.3651	3.2439	4.5498	5.9618	6.6317	6.8541	4.6964	30.50 Y
Z	3.00											3.00 Z
Y	25.50	1.7468	1.5568	1.7067	2.2048	3.1756	4.7788	6.6187	7.4885	6.7235	4.9431	25.50 Y
Z	3.00											3.00 Z
Y	20.50	1.4914	1.3042	1.4526	1.9513	2.9671	4.7929	6.8159	7.7536	6.9343	4.9809	20.50 Y
Z	3.00											3.00 Z

TEST GRID 3 COORDINATES OF CENTER X 210.00, Y 39.00, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 170.00	X 180.00	X 190.00	X 200.00	X 210.00	X 220.00	X 230.00	X 240.00	X 250.00	X 260.00	
Y	80.50	2.0113	1.9963	1.9962	2.0656	2.1851	2.3094	2.3955	2.4273	2.3989	2.3168	80.50 Y
Z	9.00											9.00 Z
Y	75.50	2.0391	1.9965	2.0201	2.1282	2.2983	2.4598	2.5773	2.6238	2.5813	2.4682	75.50 Y
Z	9.00											9.00 Z
Y	70.50	2.0585	1.9884	2.0351	2.1928	2.4217	2.6450	2.8065	2.8700	2.8152	2.6586	70.50 Y
Z	9.00											9.00 Z
Y	65.50	2.0678	1.9713	2.0447	2.2545	2.5745	2.8579	3.0745	3.1609	3.0892	2.8790	65.50 Y
Z	9.00											9.00 Z
Y	60.50	2.0773	1.9449	2.0534	2.3325	2.7276	3.1011	3.3898	3.5069	3.4121	3.1319	60.50 Y
Z	9.00											9.00 Z
Y	55.50	2.0943	1.9511	2.0653	2.4045	2.8815	3.3777	3.7621	3.9212	3.7947	3.4220	55.50 Y
Z	9.00											9.00 Z
Y	50.50	2.1009	1.9624	2.0653	2.4571	3.0435	3.6912	4.2029	4.4201	4.2493	3.7543	50.50 Y
Z	9.00											9.00 Z
Y	45.50	2.1111	1.9605	2.0690	2.4952	3.2125	4.0431	4.7226	5.0216	4.7885	4.1324	45.50 Y
Z	9.00											9.00 Z
Y	40.50	2.1007	1.9284	2.0548	2.5134	3.3803	4.4249	5.3946	5.8497	5.4847	4.5517	40.50 Y
Z	9.00											9.00 Z
Y	35.50	2.0509	1.8520	2.0025	2.5259	3.5313	4.8894	6.2753	6.9338	6.3948	5.0527	35.50 Y
Z	9.00											9.00 Z
Y	30.50	1.9440	1.7299	1.8944	2.4877	3.6479	5.3777	7.3080	8.2803	7.4612	5.5787	30.50 Y
Z	9.00											9.00 Z
Y	25.50	1.7672	1.5468	1.7177	2.3663	3.6465	5.7859	8.4919	9.9828	8.6859	6.03[illegible]3	25.50 Y
Z	9.00											9.00 Z
Y	20.50	1.5169	1.2914	1.4701	2.1336	3.4662	5.9716	9.7382	11.9310	9.9676	6.2681	20.50 Y
Z	9.00											9.00 Z

00100 0000						
00110	TEST 55 1X1500W Q 45 FT SPACING 15 FT MOUNTING H120 V63					
00120	Q1500WML	0.95	0.85	1.00		
00130	9999999999					
00140	Q1500WML	0.00	0.00	15.00	90.00	60.
00150	Q1500WML	50.00	0.00	15.00	90.00	60.00
00160	Q1500WML	100.00	0.00	15.00	90.00	60.00
00170	Q1500WML	150.00	0.00	15.00	90.00	60.00
00180	9999999999					
01000	90.00	22.50	0.00	0.00	0.00	
01010	5.00	5.00	10	11	V	270.00
01020	90.00	22.50	3.00	0.00	0.00	
01030	5.00	5.00	10	11	V	270.00
01040	90.00	22.50	9.00	0.00	0.00	
01050	5.00	5.00	10	11	V	270.00
01060	9999999999					

TEST 55 1X1500W 0 45 FT SPACING 15 FT MOUNTING M120 V63 PAGE 4

TEST GRID 1 COORDINATES OF CENTER X 90.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 70.00	X 75.00	X 80.00	X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	
Y 50.00 Z 0.00	2.7187	2.7148	2.7187	2.7637	2.6265	2.4634	2.3085	2.4634	2.6265	2.7637	50.00 Y 0.00 Z
Y 45.00 Z 0.00	3.1967	3.1435	3.1967	3.1908	3.2944	3.2389	3.2428	3.2389	3.2944	3.1908	45.00 Y 0.00 Z
Y 40.00 Z 0.00	3.9587	3.6600	3.9587	4.3904	4.8596	4.9018	4.9337	4.9018	4.8596	4.3904	40.00 Y 0.00 Z
Y 35.00 Z 0.00	5.0236	4.7118	5.0236	6.0918	7.2580	8.8607	9.4978	8.8607	7.2580	6.0918	35.00 Y 0.00 Z
Y 30.00 Z 0.00	6.2047	5.7264	6.2047	10.6798	17.8739	23.9675	25.9110	23.9675	17.8739	10.6788	30.00 Y 0.00 Z
Y 25.00 Z 0.00	8.3573	5.2177	8.3573	17.5820	29.8313	37.7939	39.5023	37.7939	28.8313	17.5820	25.00 Y 0.00 Z
Y 20.00 Z 0.00	-8.2681	3.6499	7.5035	17.4832	27.1477	25.1415	20.0931	25.1415	27.1477	17.4832	20.00 Y 0.00 Z
Y 15.00 Z 0.00	2.3396	.8407	2.3396	7.5665	9.0691	9.3786	8.9271	9.3786	9.0601	7.5665	15.00 Y 0.00 Z
Y 10.00 Z 0.00	.1215	0.0000	.1215	.3638	2.0213	5.4306	3.8697	5.4306	2.0213	.3638	10.00 Y 0.00 Z
Y 5.00 Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	5.00 Y 0.00 Z
Y -.00 Z 0.00	0.0000	0.0000	0.0030	0.0000	0.0030	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 0.00 Z

TEST 55 1X1500W @ 45 FT SPACING 15 FT MOUNTING H120 V63 PAGE 6

TEST GRID 2 COORDINATES OF CENTER X 90.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 70.00	X 75.00	X 80.00	X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	
Y 50.00 Z 3.00	2.4118	2.4007	2.4118	2.4741	2.3197	2.1460	2.0532	2.1460	2.3197	2.4741	50.00 Y 3.00 Z
Y 45.00 Z 3.00	2.8206	2.7668	2.8206	2.7981	2.7357	2.5836	2.5843	2.5836	2.7357	2.7981	45.00 Y 3.00 Z
Y 40.00 Z 3.00	3.2175	3.2923	3.2175	3.2354	3.3364	3.3338	3.3450	3.3338	3.3364	3.2354	40.00 Y 3.00 Z
Y 35.00 Z 3.00	3.5686	3.5916	3.5686	3.8692	4.7305	5.1585	5.2553	5.1585	4.7305	3.8692	35.00 Y 3.00 Z
Y 30.00 Z 3.00	4.2147	3.6542	4.2147	5.7412	7.8362	9.1683	9.4148	9.1683	7.8362	5.7412	3[illegible] Y [illegible] Z
Y 25.00 Z 3.00	4.6229	3.7057	4.6229	7.9233	17.6108	28.8639	32.5245	28.8639	17.6108	7.9233	25.00 Y 3.00 Z
Y 20.00 Z 3.00	8.1559	2.1115	4.1782	14.7304	36.1954	57.5780	61.7174	57.5780	36.1954	14.7304	20.00 Y 3.00 Z
Y 15.00 Z 3.00	2.0843	.5903	2.0843	12.6701	32.3578	26.9944	22.9803	26.9944	32.3578	12.6701	15.00 Y 3.00 Z
Y 10.00 Z 3.00	.1627	0.0000	.1627	1.3260	6.8525	11.2109	12.0623	11.2109	6.8525	1.3260	10.00 Y 3.00 Z
Y 5.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	.0018	.0000	0.0000	.0000	.0018	0.0000	5.00 Y 3.00 Z
Y .00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 3.00 Z

TEST 55 1X1500W @ 45 FT SPACING 15 FT MOUNTING H120 V63

TEST GRID 3 COORDINATES OF CENTER X 40.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.30, VERT 0.00

		X 70.00	X 75.00	X 80.00	X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	
Y 50.00	Z 9.00	1.7960	1.7799	1.7960	1.8539	1.7234	1.5405	1.4828	1.5404	1.7234	1.8539	50.00 Y 9.00 Z
Y 45.00	Z 9.00	2.0839	2.0348	2.0839	2.0979	2.0859	1.9998	2.0168	1.9998	2.0859	2.0979	45.00 Y 9.00 Z
Y 40.00	Z 9.00	2.3534	2.3524	2.3534	2.3773	2.5199	2.5719	2.5941	2.5719	2.5199	2.3773	40.00 Y 9.00 Z
Y 35.00	Z 9.00	2.4321	2.5205	2.4021	2.6597	3.2622	3.4342	3.4614	3.4342	3.2622	2.6597	35.00 Y 9.00 Z
Y 30.00	Z 9.00	2.2896	1.8806	2.2896	3.2283	4.2672	4.8112	4.8672	4.8112	4.2672	3.2283	30.00 Y 9.00 Z
Y 25.00	Z 9.00	1.9889	.7506	1.9889	3.8867	5.7606	7.2898	7.4622	7.2898	5.7606	3.8867	25.00 Y 9.00 Z
Y 20.00	Z 9.00	1.0497	.3769	.9627	4.3860	8.4839	12.3831	13.0031	12.3831	8.4839	4.3860	20.00 Y 9.00 Z
Y 15.00	Z 9.00	.3015	0.0000	.3015	3.7254	13.1335	31.0433	37.6592	31.0433	13.1335	3.7254	15.00 Y 9.00 Z
Y 10.00	Z 9.00	.0101	0.0000	.0101	.4074	16.3052	144.7714	246.8694	144.7714	16.3052	.4074	10.00 Y 9.00 Z
Y 5.00	Z 9.00	0.0000	0.0000	0.0000	0.0000	.6506	27.4100	41.2492	27.4100	.6506	0.0000	5.00 Y 9.00 Z
Y -.00	Z 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 9.00 Z

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00100 0000
00110         TEST 55A 1X1500W Q 50 FT SPACING 15 FT MOUNTING H120 V63
00120         Q1500WML          0.95         0.85         1.00
00130         9999999999
00140         Q1500WML          0.00         0.00        15.00        90.00        65.00
00150         Q1500WML         50.00         0.00        15.00        90.00        65.00
00160         Q1500WML        100.00         0.00        15.00        90.00        65.00
00170         Q1500WML        150.00         0.00        15.00        90.00        65.00
00180         9999999999
01000              90.00       40.00         0.00         0.00         0.00
01010               5.00        5.00           10           17            V       270.00
01020              90.00       40.00         3.00         0.00         0.00
01030               5.00        5.00           10           17            V       270.00
01040              90.00       40.00         9.00         0.00         0.00
01050               5.00        5.00           10           17            V       270.00
01060         9999999999
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TEST GRID 1 COORDINATES OF CENTER X 90.00, Y 40.00, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 70.00	X 75.00	X 80.00	X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	
Y	82.50	1.6400	1.6443	1.6400	1.6282	1.6261	1.6150	1.6047	1.5990	1.5931	1.5764	82.50 Y
Z	0.00											0.00 Z
Y	77.50	1.8014	1.7948	1.8014	1.7907	1.7783	1.7809	1.7759	1.7660	1.7476	1.7449	77.50 Y
Z	0.00											0.00 Z
Y	72.50	1.9972	1.9839	1.9972	1.9821	1.9586	1.9550	1.9764	1.9433	1.9366	1.9452	72.50 Y
Z	0.00											0.00 Z
Y	67.50	2.2297	2.2210	2.2297	2.2070	2.1758	2.1644	2.1787	2.1624	2.1644	2.1814	67.50 Y
Z	0.00											0.00 Z
Y	62.50	2.5710	2.5208	2.5710	2.6020	2.5974	2.5912	2.5928	2.5912	2.5970	2.5908	62.50 Y
Z	0.00											0.00 Z
Y	57.50	3.1471	3.1495	3.1471	3.1967	3.2019	3.1569	3.1671	3.1567	3.2014	3.1955	57.50 Y
Z	0.00											0.00 Z
Y	52.50	3.9323	3.9236	3.9323	4.0496	4.0218	3.9567	3.9835	3.9565	4.0213	4.0485	52.50 Y
Z	0.00											0.00 Z
3 Y	47.50	4.9308	4.8601	4.9308	5.1065	5.1895	5.1058	5.1614	5.1057	5.1891	5.1057	47.50 Y
Z	0.00											0.00 Z
Y	42.50	6.3810	5.9350	6.3810	7.7047	9.3591	10.1923	10.5188	10.1923	9.3590	7.7043	42.50 Y
Z	0.00											0.00 Z
Y	37.50	9.3234	8.3010	9.3234	12.5041	16.7872	18.7612	19.5228	18.7612	16.7872	12.5041	37.50 Y
Z	0.00											0.00 Z
Y	32.50	12.8189	10.8681	12.8189	18.2551	23.8820	26.7298	27.4377	26.7298	23.8820	18.2551	32.50 Y
Z	0.00											0.00 Z
Y	27.50	13.8495	11.6413	13.8495	19.9044	28.5859	31.2165	30.2526	31.2165	28.5858	19.9044	27.50 Y
Z	0.00											0.00 Z
Y	22.50	10.8970	8.0817	10.8970	16.0544	16.1218	13.0804	12.3162	13.0804	16.1218	16.0544	22.50 Y
Z	0.00											0.00 Z
Y	17.50	4.4681	1.5389	4.4681	5.8210	7.4124	8.3968	7.8742	8.3968	7.4124	5.8210	17.50 Y
Z	0.00											0.00 Z
Y	12.50	.3634	.1989	.3634	1.4651	3.4334	6.2153	4.7970	6.2153	3.4334	1.4651	12.50 Y
Z	0.00											0.00 Z
Y	7.50	0.0000	0.0000	0.0000	.0015	.0229	0.0000	0.0000	0.0000	.0229	.0015	7.50 Y
Z	0.00											0.00 Z

TEST 55A 1X1500W @ 50 FT SPACING 15 FT MOUNTING H120 V63 PAGE 7

TEST GRID 2 COORDINATES OF CENTER X 90.00, Y 40.00, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 70.00	X 75.00	X 80.00	X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	
Y	82.50	1.4941	1.5033	1.4941	1.4815	1.4839	1.4808	1.4740	1.4685	1.4566	1.4416	82.50 Y
Z	3.00											3.00 Z
Y	77.50	1.6304	1.6210	1.6304	1.6213	1.6154	1.6276	1.6264	1.6162	1.5918	1.5860	77.50 Y
Z	3.00											3.00 Z
Y	72.50	1.7971	1.7816	1.7971	1.7854	1.7705	1.7765	1.8103	1.7675	1.7535	1.7577	72.50 Y
Z	3.00											3.00 Z
Y	67.50	2.0002	1.9944	2.0002	1.9794	1.9569	1.9573	1.9715	1.9557	1.9483	1.9610	67.50 Y
Z	3.00											3.00 Z
Y	62.50	2.2532	2.2499	2.2532	2.2298	2.1906	2.1703	2.1571	2.1703	2.1906	2.2225	62.50 Y
Z	3.00											3.00 Z
Y	57.50	2.5488	2.5602	2.5488	2.5579	2.5065	2.4114	2.3993	2.4114	2.5065	2.5579	57.50 Y
Z	3.00											3.00 Z
Y	52.50	2.9170	2.9285	2.9170	2.9479	2.9052	2.8326	2.8255	2.8326	2.9052	2.9479	5 Y
Z	3.00											[illegible] Z
Y	47.50	3.5220	3.3983	3.5220	3.7018	3.7796	3.7220	3.7181	3.7220	3.7796	3.7018	47.50 Y
Z	3.00											3.00 Z
Y	42.50	4.5058	4.3193	4.5058	4.7802	5.1154	5.0866	5.0880	5.0866	5.1154	4.7802	42.50 Y
Z	3.00											3.00 Z
Y	37.50	5.5837	5.3535	5.5837	6.3326	7.2341	7.5129	7.9066	7.5129	7.2341	6.3326	37.50 Y
Z	3.00											3.00 Z
Y	32.50	6.6754	6.0825	6.6754	10.1146	15.2064	18.9259	20.1776	18.9259	15.2064	10.1146	32.50 Y
Z	3.00											3.00 Z
Y	27.50	9.2678	6.4313	9.2678	16.6746	28.9662	37.1326	38.6943	37.1326	28.9662	16.6746	27.50 Y
Z	3.00											3.00 Z
Y	22.50	9.8462	5.9299	9.8462	20.8273	36.5202	51.5089	49.8408	51.5089	36.5202	20.8273	22.50 Y
Z	3.00											3.00 Z
Y	17.50	6.0091	1.5472	6.0091	18.0130	23.1439	19.8299	18.2318	19.8299	23.1439	18.0130	17.50 Y
Z	3.00											3.00 Z
Y	12.50	.8216	.2362	.8216	3.9889	8.0032	11.3710	11.4961	11.3710	8.0032	3.9889	12.50 Y
Z	3.00											3.00 Z
Y	7.50	0.0000	0.0000	0.0000	.0548	.3012	.7300	0.0000	.7300	.3012	.0548	7.50 Y
Z	3.00											3.00 Z

TEST GRID 3 COORDINATES OF CENTER X 90.00, Y 40.00, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 70.00	X 75.00	X 80.00	X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	
Y 82.50 Z 9.00	1.2873	1.2939	1.2873	1.2838	1.2946	1.2927	1.2883	1.2880	1.2851	1.2688	82.50 Y 9.00 Z
Y 77.50 Z 9.00	1.3841	1.3697	1.3841	1.3868	1.3861	1.4006	1.4021	1.3963	1.3772	1.3733	77.50 Y 9.00 Z
Y 72.50 Z 9.00	1.5051	1.4860	1.5051	1.5024	1.4911	1.4997	1.5339	1.4963	1.4846	1.4917	72.50 Y 9.00 Z
Y 67.50 Z 9.00	1.6555	1.6510	1.6555	1.6346	1.6144	1.6144	1.6258	1.6139	1.6111	1.6274	67.50 Y 9.00 Z
Y 62.50 Z 9.00	1.8446	1.8414	1.8446	1.8152	1.7638	1.7347	1.7136	1.7347	1.7638	1.8122	62.50 Y 9.00 Z
Y 57.50 Z 9.00	2.0565	2.0617	2.0565	2.0605	1.9800	1.8427	1.8200	1.8427	1.9800	2.0605	57.50 Y 9.00 Z
Y 52.50 Z 9.00	2.3081	2.3095	2.3081	2.3421	2.2028	2.0209	1.9614	2.0209	2.2028	2.3421	52.50 Y 9.00 Z
Y 47.50 Z 9.00	2.6070	2.5869	2.6070	2.6115	2.4819	2.3011	2.2496	2.3011	2.4819	2.6115	47.50 Y 9.00 Z
Y 42.50 Z 9.00	2.9476	2.9004	2.9476	2.8738	2.8813	2.7882	2.7904	2.7882	2.8813	2.8738	42.50 Y 9.00 Z
Y 37.50 Z 9.00	3.1364	3.2508	3.1364	3.2498	3.6011	3.6223	3.6294	3.6223	3.6011	3.2498	37.50 Y 9.00 Z
Y 32.50 Z 9.00	3.2923	3.2003	3.2923	3.8496	4.6416	4.9750	5.0342	4.9750	4.6416	3.8496	32.50 Y 9.00 Z
Y 27.50 Z 9.00	3.3753	2.7040	3.3753	4.6353	6.2534	7.3274	7.4977	7.3274	6.2534	4.6353	27.50 Y 9.00 Z
Y 22.50 Z 9.00	2.9112	1.9000	2.9112	5.5803	10.2432	14.5861	15.4119	14.5861	10.2432	5.5803	22.50 Y 9.00 Z
Y 17.50 Z 9.00	1.9369	.1333	1.9369	6.8985	17.6581	39.4782	51.8606	39.4782	17.6581	6.8985	17.50 Y 9.00 Z
Y 12.50 Z 9.00	.2899	.0265	.2898	4.3606	35.2408	131.4741	182.8697	131.4741	35.2408	4.3606	12.50 Y 9.00 Z
Y 7.50 Z 9.00	0.0000	0.0000	0.0000	.2771	10.5436	51.5349	51.3267	51.5349	10.5436	.2771	7.50 Y 9.00 Z

00100	0000					
00110	TEST 59 2X1500 Q 120 FT SPACING 15 FT MTG HT H119 V99					
00120	Q1500WM2L	0.95	0.85	1.00		
00130	9999999999					
00140	Q1500WM2L	0.00	0.00	15.00	135.00	70.00
00150	Q1500WM2L	0.00	0.00	15.00	45.00	70.00
00160	Q1500WM2L	120.00	0.00	15.00	135.00	70.00
00170	Q1500WM2L	120.00	0.00	15.00	45.00	70.00
00180	Q1500WM2L	240.00	0.00	15.00	135.00	70.00
00190	Q1500WM2L	240.00	0.00	15.00	45.00	70.00
00200	Q1500WM2L	360.00	0.00	15.00	135.00	70.00
00210	Q1500WM2L	360.00	0.00	15.00	45.00	70.00
00220	Q1500WM2L	480.00	0.00	15.00	135.00	70.00
00230	Q1500WM2L	480.00	0.00	15.00	45.00	70.00
00240	9999999999					
00250	210.00	22.50	0.00	0.00	0.00	
00260	5.00	5.00	13	13	V	270.00
00270	210.00	22.50	3.00	0.00	0.00	
00280	5.00	5.00	13	13	V	270.00
00290	210.00	22.50	9.00	0.00	0.00	
00300	5.00	5.00	13	13	V	270.00
00310	9999999999					

TEST 59 2X1500 Q 120 FT SPACING 15 FT MTG HT H119 V99 PAGE 4

TEST GRID 1 COORDINATES OF CENTER X 210.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 182.50	X 187.50	X 192.50	X 197.50	X 202.50	X 207.50	X 212.50	X 217.50	X 222.50	X 227.50	
Y 55.00 Z 0.00	3.1935	3.2862	3.4713	3.7272	4.0507	4.4324	4.6933	4.8640	4.8185	4.4891	55.00 Y 0.00 Z
Y 50.00 Z 0.00	3.3748	3.4909	3.7365	4.1123	4.5684	5.1098	5.6445	5.8593	5.8167	5.3419	50.00 Y 0.00 Z
Y 45.00 Z 0.00	3.4990	3.6665	3.9855	4.4793	5.1397	5.8583	6.4413	6.7884	6.8761	6.4332	45.00 Y 0.00 Z
Y 40.00 Z 0.00	3.5552	3.7639	4.1832	4.8041	5.5878	6.3548	7.1500	7.9311	8.1824	7.8991	40.00 Y 0.00 Z
Y 35.00 Z 0.00	3.5148	3.7375	4.2379	4.9947	5.7668	6.7535	7.9015	9.0641	9.8503	9.8910	35.00 Y 0.00 Z
Y 30.00 Z 0.00	3.2729	3.5807	4.1653	4.8331	5.7846	7.0066	8.5308	10.2383	11.9231	12.3496	30.00 Y 0.00 Z
Y 25.00 Z 0.00	2.8796	3.1829	3.7222	4.4610	5.5023	6.9572	8.8829	11.2665	12.8249	12.5830	25.00 Y 0.00 Z
Y 20.00 Z 0.00	2.3380	2.6181	3.0318	3.7346	4.6444	6.4476	8.6420	10.6283	11.2001	10.3713	20.00 Y 0.00 Z
Y 15.00 Z 0.00	1.6655	1.8584	2.1957	2.7904	3.7097	5.1507	7.2075	8.1760	7.7419	7.1093	15.00 Y 0.00 Z
Y 10.00 Z 0.00	.9985	1.1019	1.3040	1.6664	2.2727	3.2841	4.4041	4.8845	4.4770	4.7593	10.00 Y 0.00 Z
Y 5.00 Z 0.00	.3998	.4379	.5174	.6610	.9043	1.3185	1.6872	1.8167	2.0350	2.3422	5.00 Y 0.00 Z
Y -.00 Z 0.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 0.00 Z
Y -5.00 Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 0.00 Z

TEST GRID 1 COORDINATES OF CENTER X 210.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X	X	X	X	X	X	X	X	X	X	
		232.50	237.50	242.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Y	55.00	4.7976	4.6298	4.5386	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	50.00	5.5578	5.3474	5.2470	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	45.00	6.5366	6.2681	6.1637	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	40.00	6.9398	7.4625	7.3686	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	35.00	8.5983	9.0412	8.9944	0.0530	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	30.00	10.5563	10.3141	10.4106	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	25.00	10.5861	9.6754	10.1616	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	20.00	7.9959	7.4495	8.6149	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	15.00	6.4657	5.7415	6.7460	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	10.00	5.1379	4.0686	4.0686	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	5.00	3.0110	.0795	.0295	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	.00	.0000	.0000	.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	0.00											0.00 Z

TEST 59 2X1500 Q 120 FT SPACING 15 FT MTG HT H119 V99

TEST GRID 2 COORDINATES OF CENTER X 210.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 182.50	X 187.50	X 192.50	X 197.50	X 202.50	X 207.50	X 212.50	X 217.50	X 222.50	X 227.50	
Y 55.00 Z 3.00	2.6650	2.7441	2.9022	3.1230	3.4024	3.7333	3.9700	4.1349	4.1193	3.8633	55.00 Y 3.00 Z
Y 50.00 Z 3.00	2.8180	2.9179	3.1278	3.4489	3.8428	4.3134	4.7853	5.0835	5.2249	4.9343	50.00 Y 3.00 Z
Y 45.00 Z 3.00	2.9262	3.0685	3.3418	3.7642	4.3337	4.9974	5.7700	6.3756	6.7364	6.5115	45.00 Y 3.00 Z
Y 40.00 Z 3.00	2.9794	3.1571	3.5155	4.0509	4.8124	5.8019	6.9342	8.1539	8.6644	8.4119	40.00 Y 3.00 Z
Y 35.00 Z 3.00	2.9529	3.1449	3.5751	4.2843	5.2794	6.6377	8.3122	9.6497	10.5938	10.7368	35.00 Y 3.00 Z
Y 30.00 Z 3.00	2.7606	3.0239	3.5287	4.3632	5.6428	7.3611	9.0854	11.0579	13.0677	13.7191	30.00 Y 3.00 Z
Y 25.00 Z 3.00	2.4403	2.7017	3.2709	4.2563	5.7247	7.3939	9.5942	12.3845	15.4820	17.7932	25.00 Y 3.00 Z
Y 20.00 Z 3.00	1.9921	2.2351	2.7650	3.7209	5.1179	6.9389	9.4846	13.1312	17.8519	20.0479	20.00 Y 3.00 Z
Y 15.00 Z 3.00	1.4286	1.6232	2.0675	2.8972	3.9539	5.6098	8.3357	12.4578	15.8183	15.8383	15.00 Y 3.00 Z
Y 10.00 Z 3.00	.8635	.9827	1.2581	1.7454	2.4365	3.6120	5.6871	8.7023	10.3188	8.9891	10.00 Y 3.00 Z
Y 5.00 Z 3.00	.3481	.3961	.5071	.6942	.9729	1.4573	2.3353	3.4271	3.8009	4.3383	5.00 Y 3.00 Z
Y -.00 Z 3.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 3.00 Z
Y -5.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 3.00 Z

TEST GRID 2 COORDINATES OF CENTER X 210.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X	X	X	X	X	X	X	X	X	X	
		232.50	237.50	242.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Y	55.00	4.1915	4.0998	4.0096	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	50.00	5.2493	5.1226	5.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	45.00	6.7707	6.5915	6.4207	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	40.00	7.2963	8.0229	7.8270	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	35.00	9.3710	9.9351	9.7326	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.
Z	3.00											0.00 Z
Y	30.00	12.4262	12.6139	12.4625	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	25.00	17.0406	15.9494	16.0726	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	20.00	17.9461	15.0816	16.0130	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	15.00	12.4675	11.[illegible]713	13.3622	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	10.00	8.7307	8.1665	8.1665	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	5.00	5.2272	.0260	.0260	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	.00	.0000	[illegible]	.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z

TEST GRID 3 COORDINATES OF CENTER X 210.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X	X	X	X	X	X	X	X	X	X	
		182.50	187.50	192.50	197.50	202.50	207.50	212.50	217.50	222.50	227.50	
Y	55.00	1.6804	1.7155	1.7850	1.8834	2.0374	2.2346	2.3951	2.5257	2.5617	2.4675	55.00 Y
Z	9.00											9.00 Z
Y	50.00	1.7269	1.7705	1.8604	2.0382	2.2689	2.5478	2.8379	3.0541	3.1942	3.0967	50.00 Y
Z	9.00											9.00 Z
Y	45.00	1.7493	1.8083	1.9631	2.2046	2.5283	2.9203	3.3437	3.7826	4.0699	4.0356	45.00 Y
Z	9.00											9.00 Z
Y	40.00	1.7423	1.8427	2.0489	2.3566	2.7923	3.3650	4.0460	4.8026	5.3244	5.4920	40.00 Y
Z	9.00											9.00 Z
Y	35.00	1.7049	1.8311	2.0814	2.4835	3.0565	3.8477	4.8743	6.0901	7.2064	7.8468	35.00 Y
Z	9.00											9.00 Z
Y	30.00	1.5972	1.7622	2.0578	2.5377	3.2741	4.3328	5.8184	7.7598	10.0634	11.5618	30.00 Y
Z	9.00											9.00 Z
Y	25.00	1.4288	1.5492	1.9216	2.4894	3.3503	4.7066	6.7752	9.8094	13.8485	17.9189	25.00 Y
Z	9.00											9.00 Z
Y	20.00	1.1875	1.3329	1.6484	2.2103	3.1797	4.7942	7.4369	11.8926	18.9740	28.6304	20.00 Y
Z	9.00											9.00 Z
Y	15.00	.8723	.9881	1.2979	1.7572	2.6266	4.2076	7.2575	12.9993	24.1351	39.1350	15.00 Y
Z	9.00											9.00 Z
Y	10.00	.5434	.6156	.7872	1.1114	1.7195	2.9142	5.4501	11.0104	22.8260	43.9520	10.00 Y
Z	9.00											9.00 Z
Y	5.00	.2246	.2549	.3266	.4632	.7230	1.2453	2.3923	5.2049	11.3240	28.4505	5.00 Y
Z	9.00											9.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y
Z	9.00											9.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	9.00											9.00 Z

TEST 59 2X1500 Q 120 FT SPACING 15 FT MTG HT H119 V99

TEST GRID 3 COORDINATES OF CENTER X 210.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X	X	X	X	X	X	X	X	X	X	
		232.50	237.50	242.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Y	55.00	2.7581	2.7791	2.7003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	50.00	3.4071	3.4326	3.3260	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	45.00	4.3533	4.3864	4.2374	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	40.00	5.0488	5.8333	5.6166	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	35.00	7.2849	8.1903	7.8189	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	30.00	11.2606	12.1098	11.5686	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	25.00	18.9214	19.4623	18.4963	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	20.00	33.5222	31.7771	30.2237	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	15.00	53.1325	51.2909	50.0367	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	10.00	77.6210	60.0539	60.0539	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	5.00	37.7355	32.0752	32.0752	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	.00	.0000	.0000	.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z

00100	0000					
00110	TEST 75A	2X LP90WMSE	100 FT SPACING 15 FT MTG			H140 V90
00120	LP90WMSE	1.00	0.85	1.00		
00130	9999999999					
00140	LP90WMSE	0.00	0.00	15.00	45.00	70.00
00150	LP90WMSE	100.00	0.00	15.00	45.00	70.00
00160	LP90WMSE	100.00	0.00	15.00	135.00	70.00
00170	LP90WMSE	200.00	0.00	15.00	45.00	70.00
00180	LP90WMSE	200.00	0.00	15.00	135.00	70.00
00190	LP90WMSE	300.00	0.00	15.00	45.00	70.00
00200	LP90WMSE	300.00	0.00	15.00	135.00	70.00
00210	LP90WMSE	200.00	0.00	15.00	135.00	70.00
00220	9999999999					
00230	190.00	22.50	0.00	0.00	0.00	
00240	5.00	5.00	20	13	V	270.00
00250	190.00	22.50	3.00	0.00	0.00	
00260	5.00	5.00	20	13	V	270.00
00270	190.00	22.50	9.00	0.00	0.00	
00280	5.00	5.00	20	13	V	270.00
00290	9999999999					

TEST 754 2X LP90WMSE 100 FT SPACING 15 FT MTG H140 V90

TEST GRID 1 COORDINATES OF CENTER X 190.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 145.00	X 150.00	X 155.00	X 160.00	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	
Y	55.00	1.7791	1.8584	1.9770	2.1354	2.2952	2.4428	2.7029	2.9444	3.1749	3.3723	55.00 Y
Z	0.00											0.00 Z
Y	50.00	1.9077	2.0030	2.1458	2.3494	2.6120	2.8216	3.0038	3.4303	3.7677	4.0590	50.00 Y
Z	0.00											0.00 Z
Y	45.00	2.0268	2.1224	2.3098	2.5701	2.9172	3.3003	3.5773	4.0300	4.5302	4.9746	45.00 Y
Z	0.00											0.00 Z
Y	40.00	2.1117	2.2104	2.4283	2.7800	3.2329	3.8190	4.3443	4.6611	5.5176	6.2193	40.00 Y
Z	0.00											0.00 Z
Y	35.00	2.1492	2.2477	2.4796	2.8973	3.5389	4.3289	5.3286	5.8123	6.4040	7.2257	35.00 Y
Z	0.00											0.00 Z
Y	30.00	2.1066	2.1758	2.4376	2.9187	3.6823	4.8288	5.8404	6.6600	6.9376	8.3469	30.00 Y
Z	0.00											0.00 Z
Y	25.00	1.9343	2.0058	2.2803	2.7983	3.6500	4.7276	5.9011	7.0167	7.8990	9.4546	2[illegible] Y
Z	0.00											0.[illegible] Z
Y	20.00	1.6522	1.7304	1.9984	2.5052	3.3112	4.2519	5.4748	6.8571	7.9734	8.2983	20.00 Y
Z	0.00											0.00 Z
Y	15.00	1.3041	1.3441	1.5922	2.0368	2.6525	3.5022	4.6915	5.9944	6.4648	5.9682	15.00 Y
Z	0.00											0.00 Z
Y	10.00	.8809	.9197	1.0835	1.4134	1.8317	2.4715	3.4384	4.1641	3.9844	4.3973	10.00 Y
Z	0.00											0.00 Z
Y	5.00	.4281	.4468	.5269	.6791	.8808	1.2015	1.6855	1.9794	2.0189	2.0888	5.00 Y
Z	0.00											0.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST 7SA 2X LP90WMSE 100 FT SPACING 15 FT MTG H140 V9

TEST GRID 1 COORDINATES OF CENTER X 190.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 195.00	X 200.00	X 205.00	X 210.00	X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	
Y 55.00	Z 0.00	3.5124	3.3954	3.1878	2.7902	2.3817	1.9805	1.6335	1.3923	1.3303	1.2792	55.00 Y 0.00 Z
Y 50.00	Z 0.00	4.2656	4.1463	3.8513	3.2975	2.7260	2.1845	1.6589	1.5827	1.4711	1.3938	50.00 Y 0.00 Z
Y 45.00	Z 0.00	5.2880	5.1755	4.7411	3.9482	3.1385	2.3894	1.9103	1.7634	1.6253	1.5134	45.00 Y 0.00 Z
Y 40.00	Z 0.00	6.5961	6.4637	5.8493	4.7867	3.5808	2.4433	2.2266	1.9386	1.7927	1.6384	40.00 Y 0.00 Z
Y 35.00	Z 0.00	7.7322	7.5860	6.7141	5.3323	3.8470	2.8194	2.6217	2.2711	1.9690	1.7127	35.00 Y 0.00 Z
Y 30.00	Z 0.00	9.1112	8.9215	7.7168	5.8366	3.5415	3.2546	2.9401	2.5704	2.0829	1.7528	30.00 Y 0.00 Z
Y 25.00	Z 0.00	10.5669	10.2016	8.6197	6.1810	3.9697	3.5043	3.0654	2.5938	2.1256	1.6668	25.00 Y 0.00 Z
Y 20.00	Z 0.00	9.2713	9.9460	6.5344	4.2163	4.0595	3.5099	2.9146	2.3655	1.8588	1.4369	20.00 Y 0.00 Z
Y 15.00	Z 0.00	6.4325	8.0756	4.2803	3.0343	3.2869	3.0582	2.4580	1.8516	1.4291	1.1483	15.00 Y 0.00 Z
Y 10.00	Z 0.00	4.1912	4.7254	2.1204	2.2316	2.0282	2.1224	1.7656	1.2911	.9840	.7930	10.00 Y 0.00 Z
Y 5.00	Z 0.00	2.0093	.0292	1.0194	1.0632	1.0263	1.0236	.8676	.6272	.4732	.3813	5.00 Y 0.00 Z
Y .00	Z 0.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 0.00 Z
Y -5.00	Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 0.00 Z

TEST 79A 2X LP90WMSE 100 FT SPACING 18 FT MTG M140 V9 PAGE 7

TEST GRID 2 COORDINATES OF CENTER X 190.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 145.00	X 150.00	X 155.00	X 160.00	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	
Y	55.00	1.6149	1.6790	1.7802	1.9170	2.0835	2.2550	2.5382	2.7552	2.9423	3.1501	55.00 Y
Z	3.00											3.00 Z
Y	50.00	1.7255	1.7984	1.9241	2.1084	2.3459	2.5008	2.8071	3.2209	3.5202	3.8021	50.00 Y
Z	3.00											3.00 Z
Y	45.00	1.8312	1.9097	2.0494	2.3060	2.6215	2.9868	3.3113	3.8034	4.2661	4.6421	45.00 Y
Z	3.00											3.00 Z
Y	40.00	1.9100	2.0020	2.1898	2.4978	2.9117	3.4476	3.9028	4.4000	5.2395	5.8990	40.00 Y
Z	3.00											3.00 Z
Y	35.00	1.9619	2.0508	2.2631	2.6354	3.1997	3.9269	4.8585	5.5614	6.5274	7.6156	35.00 Y
Z	3.00											3.00 Z
Y	30.00	1.9391	2.0128	2.2571	2.6954	3.3807	4.4088	5.7158	7.2429	8.0491	9.7559	30.00 Y
Z	3.00											3.00 Z
Y	25.00	1.8098	1.8852	2.1418	2.6200	3.4080	4.6517	6.6017	8.7838	9.9734	11.5730	25. Y
Z	3.00											3 Z
Y	20.00	1.5620	1.6351	1.8435	2.3781	3.2008	4.5790	6.6979	8.9974	11.2331	12.6972	20.00 Y
Z	3.00											3.00 Z
Y	15.00	1.2318	1.2876	1.5079	1.9425	2.7058	4.0288	5.7590	8.1416	10.8666	12.2695	15.00 Y
Z	3.00											3.00 Z
Y	10.00	.8341	.8702	1.0280	1.3497	1.9334	2.8936	4.2255	6.3421	8.1866	7.7041	10.00 Y
Z	3.00											3.00 Z
Y	5.00	.4071	.4245	.5023	.6617	.9571	1.4223	2.1279	3.3373	3.9225	4.1242	5.00 Y
Z	3.00											3.00 Z
Y	0.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y
Z	3.00											3.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	3.00											3.00 Z

TEST 75A 2X LP90WMSE 100 FT SPACING 15 FT MTG H140 V9

TEST GRID 2 COORDINATES OF CENTER X 190.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 195.00	X 200.00	X 205.00	X 210.00	X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	
Y 55.00 Z 3.00	3.2848	3.1558	2.9417	2.5739	2.1964	1.8350	1.5214	1.2938	1.2268	1.1711	55.00 Y 3.00 Z
Y 50.00 Z 3.00	4.0019	3.8664	3.5652	3.0506	2.5239	2.0328	1.5522	1.4474	1.3516	1.2698	50.00 Y 3.00 Z
Y 45.00 Z 3.00	4.9878	4.8536	4.4133	3.6709	2.9147	2.2385	1.7832	1.6283	1.4865	1.3733	45.00 Y 3.00 Z
Y 40.00 Z 3.00	6.3843	6.2696	5.5959	4.4869	3.3678	2.3112	2.0744	1.8390	1.6323	1.4756	40.00 Y 3.00 Z
Y 35.00 Z 3.00	8.4306	8.3791	7.2909	5.5467	3.8534	2.8136	2.4405	2.0819	1.7853	1.5541	35.00 Y 3.00 Z
Y 30.00 Z 3.00	10.8272	10.7514	9.1450	6.6666	4.0612	3.4908	2.8840	2.3484	1.8977	1.5973	30.00 Y 3.00 Z
Y 25.00 Z 3.00	13.3256	13.2300	10.8631	7.2765	4.8529	4.2604	3.4063	2.5313	1.9452	1.5389	25.00 Y 3.00 Z
Y 20.00 Z 3.00	16.3037	15.8078	12.6716	6.3895	5.4851	4.5730	3.6135	2.5510	1.7772	1.3575	20.00 Y 3.00 Z
Y 15.00 Z 3.00	12.8074	14.8538	8.6622	6.1803	5.4828	4.2748	3.0739	2.1224	1.4495	1.0934	15.00 Y 3.00 Z
Y 10.00 Z 3.00	9.2485	9.6797	4.1528	3.8820	4.1248	3.2178	2.1555	1.4985	1.0308	.7562	10.00 Y 3.00 Z
Y 5.00 Z 3.00	4.2126	1.3188	2.1197	2.0761	1.9765	1.6866	1.0843	.7359	.5094	.3703	5.00 Y 3.00 Z
Y .00 Z 3.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 3.00 Z
Y -5.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 3.00 Z

TEST 75A 2X LP90WMSE 100 FT SPACING 15 FT MTG H140 V9 PAGE 10

TEST GRID 3 COORDINATES OF CENTER X 190.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 145.00	X 150.00	X 155.00	X 160.00	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	
Y	55.00	1.2608	1.3117	1.3894	1.4926	1.5045	1.7244	1.9432	2.1281	2.3026	2.4278	55.00 Y
Z	9.00											9.00 Z
Y	50.00	1.3391	1.3994	1.4928	1.6249	1.7946	1.9569	2.1530	2.4954	2.7482	2.9507	50.00 Y
Z	9.00											9.00 Z
Y	45.00	1.4101	1.4742	1.5916	1.7600	1.9838	2.2484	2.5261	2.9700	3.3458	3.6696	45.00 Y
Z	9.00											9.00 Z
Y	40.00	1.4636	1.5325	1.6723	1.8868	2.1781	2.5562	2.9869	3.4459	4.1669	4.6875	40.00 Y
Z	9.00											9.00 Z
Y	35.00	1.4855	1.5624	1.7208	1.9844	2.3685	2.8824	3.5409	4.2703	5.3219	6.1822	35.00 Y
Z	9.00											9.00 Z
Y	30.00	1.4623	1.5308	1.7194	2.0407	2.5232	3.2124	4.1465	5.3378	6.6619	8.[illegible]134	30.00 Y
Z	9.00											9.00 Z
Y	25.00	1.3755	1.4420	1.6437	2.0126	2.6050	3.4873	4.7849	6.6569	8.9650	11.7978	2[illegible] Y
Z	9.00											[illegible] Z
Y	20.00	1.2078	1.2624	1.4730	1.8695	2.5277	3.6055	5.3195	8.1577	12.4800	16.5974	20.00 Y
Z	9.00											9.00 Z
Y	15.00	.9599	1.0015	1.1819	1.5478	2.2143	3.3767	5.3375	9.0707	16.4928	28.1436	15.00 Y
Z	9.00											9.00 Z
Y	10.00	.6500	.6774	.8080	1.0799	1.5889	2.5300	4.3550	8.2326	17.4979	35.4133	10.00 Y
Z	9.00											9.00 Z
Y	5.00	.3167	.3297	.3951	.5335	.7990	1.2949	2.3179	4.7445	11.1635	25.0838	5.00 Y
Z	9.00											9.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y
Z	9.00											9.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	9.00											9.00 Z

TEST 75A 2X LP90WMSE 100 FT SPACING 15 FT MTG H140 V9

TEST GRID 3 COORDINATES OF CENTER X 190.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 195.00	X 200.00	X 205.00	X 210.00	X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	
Y	55.00	2.5085	2.4046	2.2373	1.9835	1.7175	1.4103	1.1418	.9929	.9449	.9067	55.00 Y
Z	9.00											9.00 Z
Y	50.00	3.0834	2.9605	2.7159	2.3923	1.9592	1.5536	1.1956	1.1115	1.0391	.9786	50.00 Y
Z	9.00											9.00 Z
Y	45.00	3.8931	3.7501	3.3783	2.8387	2.2574	1.7117	1.3767	1.2478	1.1356	1.0505	45.00 Y
Z	9.00											9.00 Z
Y	40.00	5.0754	4.9179	4.3246	3.4898	2.6257	1.8231	1.5998	1.3984	1.2329	1.1160	40.00 Y
Z	9.00											9.00 Z
Y	35.00	6.8833	6.7329	5.7282	4.3659	3.0752	2.2258	1.8688	1.5585	1.3254	1.1634	35.00 Y
Z	9.00											9.00 Z
Y	30.00	9.6495	9.5943	7.8564	5.5548	3.4060	2.7500	2.1652	1.7164	1.3961	1.1854	30.00 Y
Z	9.00											9.00 Z
Y	25.00	14.2732	14.5842	11.2867	7.0849	4.4924	3.3833	2.4742	1.8419	1.4235	1.1541	25.00 Y
Z	9.00											9.00 Z
Y	20.00	22.7599	24.3004	17.1252	8.2716	6.0930	4.1369	2.7401	1.8837	1.3624	1.0569	20.00 Y
Z	9.00											9.00 Z
Y	15.00	38.3504	42.3846	26.0050	13.1566	8.2849	4.7277	2.7515	1.7485	1.1807	.8675	15.00 Y
Z	9.00											9.00 Z
Y	10.00	50.3300	62.8098	25.1061	17.7298	9.4079	4.1820	2.2100	1.3040	.8428	.6014	10.00 Y
Z	9.00											9.00 Z
Y	5.00	30.5927	38.5131	15.3068	12.5933	5.5935	2.3855	1.1744	.6660	.4226	.2965	5.00 Y
Z	9.00											9.00 Z
Y	.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y
Z	9.00											9.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	9.00											9.00 Z

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00100 0000
00110      TEST 76F  1X 180 LP WMSE    60 FT SPACING  30 FT MTG H150 V90
00120      LP180WMSE       1.00        0.85       1.00
00130      9999999999
00140      LP180WMSE       0.00        0.00      15.00      90.00      60.00
00150      LP180WMSE      60.00        0.00      15.00      90.00      60.00
00160      LP180WMSE     120.00        0.00      15.00      90.00      60.00
00170      LP180WMSE     180.00        0.00      15.00      90.00      60.00
00180      LP180WMSE     240.00        0.00      15.00      90.00      60.00
00190      9999999999
00200          105.00     22.50        0.00       0.00       0.00
00210            5.00      5.00          10         13          V     270.00
00220          105.00     22.50        3.00       0.00       0.00
00230            5.00      5.00          10         13          V     270.00
00240          105.00     22.50        9.00       0.00       0.00
00250            5.00      5.00          10         13          V     270.00
00260      9999999999
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TEST 76F 1X 180 LP WMSE 60 FT SPACING 30 FT MTG H150 V90 PAGE 4

TEST GRID 1 COORDINATES OF CENTER X 105.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	X 130.00	
Y	55.00	1.6729	1.6599	1.6794	1.7243	1.7672	1.8040	1.8363	2.2989	1.8322	1.7969	55.00 Y
Z	0.00											0.00 Z
Y	50.00	1.9537	1.9314	1.9619	2.0357	2.1124	2.1791	2.2379	2.6339	2.2360	2.1746	50.00 Y
Z	0.00											0.00 Z
Y	45.00	2.2836	2.2452	2.2936	2.4112	2.5641	2.6933	2.7949	3.0442	2.7949	2.6916	45.00 Y
Z	0.00											0.00 Z
Y	40.00	2.6604	2.6017	2.6684	2.8553	3.1559	3.4107	3.7182	8.3648	3.7182	3.4107	40.00 Y
Z	0.00											0.00 Z
Y	35.00	3.0511	2.9659	3.0543	3.4795	4.3397	5.2443	5.8966	10.1772	5.8966	5.2443	35.00 Y
Z	0.00											0.00 Z
Y	30.00	3.1450	3.1742	3.6127	4.6265	6.2206	9.1466	9.4973	12.5640	9.4973	8.1466	30.00 Y
Z	0.00											0.00 Z
Y	25.00	3.2887	3.4193	4.0457	5.9201	8.6997	12.5045	15.0438	6.4827	15.0438	12.5043	25.00 Y
Z	0.00											0.00 Z
Y	20.00	4.0365	3.2927	4.0365	4.6279	10.8505	14.4901	17.6722	8.0321	17.6694	14.4879	20.00 Y
Z	0.00											0.00 Z
Y	15.00	3.2666	2.5278	3.2666	5.7282	9.4108	14.4555	16.5219	12.1054	16.5271	14.3472	15.00 Y
Z	0.00											0.00 Z
Y	10.00	1.8095	1.2925	1.7589	3.0472	5.8868	8.0895	9.0231	7.5448	9.0402	8.1147	10.00 Y
Z	0.00											0.00 Z
Y	5.00	.2246	0.0000	.3811	.6604	1.2810	2.1713	2.8559	2.7966	2.9003	2.1713	5.00 Y
Z	0.00											0.00 Z
Y	-.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST 76F 1X 190 LP WHSE 60 FT SPACING 30 FT MTG H150 V90

TEST GRID 2 COORDINATES OF CENTER X 105.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X	X	X	X	X	X	X	X	X	X	
		85.00	90.00	95.00	100.00	105.00	110.00	115.00	120.00	125.00	130.00	
Y Z	55.00 3.00	1.3520	1.3411	1.3591	1.3978	1.4568	1.5082	1.5575	2.3329	1.5535	1.5004	55.00 Y 3.00 Z
Y Z	50.00 3.00	1.5862	1.5683	1.5963	1.6594	1.7326	1.8120	1.8865	2.6833	1.8844	1.8072	50.00 Y 3.00 Z
Y Z	45.00 3.00	1.8653	1.8355	1.8795	1.9830	2.1202	2.2462	2.3590	3.1282	2.3590	2.2438	45.00 Y 3.00 Z
Y Z	40.00 3.00	2.1975	2.1475	2.2090	2.3759	2.6399	2.8811	3.0638	3.7222	3.0638	2.8811	40.00 Y 3.00 Z
Y Z	35.00 3.00	2.5645	2.4811	2.5645	2.8628	3.3299	3.8133	4.1584	4.5342	4.1584	3.8133	35.00 Y 3.00 Z
Y Z	30.00 3.00	2.9358	2.7168	2.9265	3.4371	4.2669	5.6080	6.7120	13.9622	6.7120	5.6080	30.[illegible] 3.[illegible]
Y Z	25.00 3.00	3.1063	2.8980	3.1037	4.2200	6.4672	9.6652	12.3744	18.2136	12.3744	9.6652	25.00 Y 3.00 Z
Y Z	20.00 3.00	3.0803	2.5750	3.0803	5.1685	9.4700	15.9505	22.6510	9.8288	22.6510	15.9505	20.00 Y 3.00 Z
Y Z	15.00 3.00	2.6305	1.9228	2.6305	5.1227	11.5590	19.4001	26.9888	13.0231	26.9930	15.4352	15.00 Y 3.00 Z
Y Z	10.00 3.00	1.4987	.9917	1.4583	3.4168	7.7682	15.8969	19.6682	11.6006	19.6756	15.9103	10.00 Y 3.00 Z
Y Z	5.00 3.00	.1595	0.0000	.3260	.9743	2.0452	4.4504	6.2635	6.5779	6.2636	4.4504	5.00 Y 3.00 Z
Y Z	-.00 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 3.00 Z
Y Z	-5.00 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 3.00 Z

TEST 76F 1X 180 LP WMSE 60 FT SPACING ~~30~~ 15 FT MTG H150 V90 PAGE 8

TEST GRID 3 COORDINATES OF CENTER X 105.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	X 130.00	
Y 55.00 Z 9.00	1.1478	1.1452	1.1525	1.1661	1.1919	1.2194	1.2492	1.3639	1.2471	1.2154	55.00 Y 9.00 Z
Y 50.00 Z 9.00	1.2591	1.2546	1.2654	1.2885	1.3242	1.3669	1.4127	1.5452	1.4117	1.3640	50.00 Y 9.00 Z
Y 45.00 Z 9.00	1.3788	1.3686	1.3894	1.4323	1.4918	1.5618	1.6306	1.7709	1.6306	1.5605	45.00 Y 9.00 Z
Y 40.00 Z 9.00	1.5162	1.4973	1.5249	1.5923	1.6975	1.8209	1.9334	2.0902	1.9334	1.8209	40.00 Y 9.00 Z
Y 35.00 Z 9.00	1.6715	1.6327	1.6643	1.7843	1.9598	2.1674	2.3687	2.5529	2.3687	2.1674	35.00 Y 9.00 Z
Y 30.00 Z 9.00	1.8408	1.7493	1.8068	1.9939	2.3318	2.8689	3.3384	6.5056	3.3384	2.8689	30.00 Y 9.00 Z
Y 25.00 Z 9.00	1.9261	1.8207	1.9039	2.3263	3.1489	4.2851	5.3450	8.9313	5.3450	4.2851	25.00 Y 9.00 Z
Y 20.00 Z 9.00	1.9534	1.7267	1.9534	2.6997	4.2796	6.7848	9.5780	13.1685	9.5780	6.7848	20.00 Y 9.00 Z
Y 15.00 Z 9.00	1.6889	1.3821	1.6889	2.7496	5.4225	10.9996	20.7429	54.4669	20.7429	11.0105	15.00 Y 9.00 Z
Y 10.00 Z 9.00	.9549	.7160	.9549	1.9742	5.1501	18.6997	62.8471	38.5993	62.8471	13.9683	10.00 Y 9.00 Z
Y 5.00 Z 9.00	.0576	0.0000	.1109	.4912	2.0405	13.3038	63.5302	46.4023	63.5302	13.3038	5.00 Y 9.00 Z
Y -.00 Z 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 9.00 Z
Y -5.00 Z 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 9.00 Z

00100	0000					
00110	TEST ONE	1X 180 LP WGQV	80 FT SPACING		15 FT MTG H150 V9	
00120	LP180WGQV	1.00	0.85	1.00		
00130	9999999999					
00140	LP180WGQV	0.00	0.00	15.00	90.00	20.00
00150	LP180WGQV	60.00	0.00	15.00	90.00	20.00
00160	LP180WGQV	120.00	0.00	15.00	90.00	20.00
00170	LP180WGQV	180.00	0.00	15.00	90.00	20.00
00180	LP180WGQV	240.00	0.00	15.00	90.00	20.00
00190	9999999999					
00200	105.00	22.50	0.00	0.00	0.00	
00210	5.00	5.00	12	13	V	270.00
00220	105.00	22.50	3.00	0.00	0.00	
00230	5.00	5.00	12	13	V	270.00
00240	105.00	22.50	9.00	0.00	0.00	
00250	5.00	5.00	12	13	V	270.00
00260	9999999999					

TEST 80E 1X 180 LP WGQV 80 FT SPACING 15 FT MTG H150 V90 PAGE 4

TEST GRID 1 COORDINATES OF CENTER X 105.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 80.00	X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	
Y	55.00	2.3843	2.3894	2.3647	2.4034	2.4089	2.4122	2.4119	2.4164	2.4248	2.4185	55.00 Y
Z	0.00											0.00 Z
Y	50.00	2.5384	2.5123	2.4982	2.5298	2.5568	2.5921	2.6254	2.6741	2.6903	2.6786	50.00 Y
Z	0.00											0.00 Z
Y	45.00	2.7240	2.6474	2.6232	2.6536	2.7345	2.8091	2.9146	2.9904	3.0191	2.9990	45.00 Y
Z	0.00											0.00 Z
Y	40.00	2.9205	2.8009	2.7604	2.7967	2.9183	3.0949	3.2641	3.3848	3.4337	3.3996	40.00 Y
Z	0.00											0.00 Z
Y	35.00	3.1673	2.9492	2.8687	2.9341	3.1441	3.4207	3.6834	3.8800	3.9635	3.9061	35.00 Y
Z	0.00											0.00 Z
Y	30.00	3.4193	3.0946	2.9405	3.0655	3.3691	3.7724	4.1920	4.5527	4.7078	4.5949	30.00 Y
Z	0.00											0.00 Z
Y	25.00	3.6286	3.1919	3.0061	3.1340	3.5569	4.1774	4.9106	5.5358	5.8072	5.6009	25.00 Y
Z	0.00											0.00 Z
Y	20.00	3.7251	3.1342	2.9053	3.0807	3.6105	4.5270	5.7022	6.8091	7.3103	6.9072	20.00 Y
Z	0.00											0.00 Z
Y	15.00	3.4974	2.7810	2.5484	2.7223	3.3664	4.5738	6.4233	8.3357	9.2237	8.4417	15.00 Y
Z	0.00											0.00 Z
Y	10.00	2.7894	2.0558	1.8275	2.0007	2.6476	4.0052	6.2047	8.3436	9.3191	8.4817	10.00 Y
Z	0.00											0.00 Z
Y	5.00	1.4806	1.0068	.8663	.9709	1.3796	2.3317	3.8119	5.3481	0.0000	5.4169	5.00 Y
Z	0.00											0.00 Z
Y	-.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST GRID 1 COORDINATES OF CENTER X 105.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 130.00	X 135.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 55.00	Z 0.00	2.4143	2.4145	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 50.00	Z 0.00	2.6345	2.5986	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 45.00	Z 0.00	2.9299	2.8225	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 40.00	Z 0.00	3.2897	3.1179	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 35.00	Z 0.00	3.7251	3.4411	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 30.00	Z 0.00	4.2589	3.8423	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 25.00	Z 0.00	5.0132	4.2451	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 20.00	Z 0.00	5.8542	4.6798	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 15.00	Z 0.00	6.6152	4.7469	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 10.00	Z 0.00	5.4400	4.2223	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 5.00	Z 0.00	3.9584	2.4884	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y .00	Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -5.00	Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

TEST 80E 1X 180 LP WGQV 80 FT SPACING 15 FT MTG H150 V90 PAGE 7

TEST GRID 2 COORDINATES OF CENTER X 105.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 80.00	X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	
Y 55.00	Z 3.00	2.5654	2.5710	2.5612	2.5773	2.5763	2.5666	2.5584	2.5550	2.5668	2.5640	55.00 Y 3.00 Z
Y 50.00	Z 3.00	2.7281	2.7312	2.7091	2.7382	2.7331	2.7496	2.7724	2.8232	2.8420	2.8324	50.00 Y 3.00 Z
Y 45.00	Z 3.00	2.8969	2.8451	2.8432	2.8439	2.8987	2.9579	3.0699	3.1501	3.1799	3.1586	45.00 Y 3.00 Z
Y 40.00	Z 3.00	3.0483	2.9372	2.9089	2.9365	3.0478	3.2614	3.4662	3.6094	3.6663	3.6235	40.00 Y 3.00 Z
Y 35.00	Z 3.00	3.3047	3.0179	2.9160	2.9995	3.2815	3.6454	3.9756	4.2207	4.3214	4.2462	35.00 Y 3.00 Z
Y 30.00	Z 3.00	3.5702	3.1377	2.9244	3.1052	3.5152	4.0703	4.6149	5.0385	5.2164	5.0841	30.00 Y 3.00 Z
Y 25.00	Z 3.00	3.7925	3.1968	3.0030	3.1440	3.6996	4.5188	5.4125	6.1475	6.4920	6.2291	25.00 Y 3.00 Z
Y 20.00	Z 3.00	3.9333	3.1768	2.9160	3.1131	3.7976	4.9912	6.5045	7.9568	8.6232	8.0915	20.00 Y 3.00 Z
Y 15.00	Z 3.00	3.8154	2.8738	2.5678	2.8078	3.6712	5.2290	7.6509	10.4007	11.7861	10.5982	15.00 Y 3.00 Z
Y 10.00	Z 3.00	3.1002	2.1528	1.8422	2.0920	2.9424	4.6921	8.0720	12.5431	14.6902	12.8113	10.00 Y 3.00 Z
Y 5.00	Z 3.00	1.6431	1.0429	.8453	1.0105	1.5242	2.7994	5.6067	9.2735	0.0000	9.4579	5.00 Y 3.00 Z
Y -.00	Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 3.00 Z
Y -5.00	Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 3.00 Z

TEST ROE 1X 180 LP 400V 80 FT SPACING 15 FT MTG H150 V90 PAGE

TEST GRID 2 COORDINATES OF CENTER X 105.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 130.00	X 135.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 55.00	Z 3.00	2.5703	2.5788	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 50.00	Z 3.00	2.7910	2.7474	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 45.00	Z 3.00	3.0884	2.9786	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 40.00	Z 3.00	3.4925	3.2623	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 35.00	Z 3.00	4.0179	3.6811	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 30.00	Z 3.00	4.6832	4.1363	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 25.00	Z 3.00	5.5334	4.6608	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 20.00	Z 3.00	6.7004	5.1803	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 15.00	Z 3.00	7.9339	5.4781	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 10.00	Z 3.00	8.4554	4.9994	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 5.00	Z 3.00	5.8905	3.0241	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y .00	Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -5.00	Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

TEST GRID 3 COORDINATES OF CENTER X 105.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 80.00	X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	
Y	55.00	2.9188	2.9339	2.9127	2.9224	2.9069	2.8638	2.8387	2.8246	2.8508	2.8534	55.00 Y
Z	9.00											9.00 Z
Y	50.00	3.1388	3.1695	3.1283	3.1517	3.1014	3.0982	3.1156	3.1813	3.2155	3.2186	50.00 Y
Z	9.00											9.00 Z
Y	45.00	3.3822	3.3285	3.3449	3.2902	3.3125	3.3732	3.5259	3.6338	3.6898	3.6753	45.00 Y
Z	9.00											9.00 Z
Y	40.00	3.6197	3.4613	3.4131	3.3970	3.5154	3.7886	4.0561	4.2437	4.3315	4.2932	40.00 Y
Z	9.00											9.00 Z
Y	35.00	3.9233	3.5198	3.2867	3.4259	3.8019	4.2942	4.7488	5.0874	5.2359	5.1543	35.00 Y
Z	9.00											9.00 Z
Y	30.00	4.2080	3.4321	3.0115	3.3597	4.0619	4.8651	5.6716	6.2954	6.5600	6.3868	30.00 Y
Z	9.00											9.00 Z
Y	25.00	4.2172	3.1808	2.9530	3.1310	4.0642	5.4152	6.9020	8.0839	8.5859	8.2059	25.00 Y
Z	9.00											9.00 Z
Y	20.00	3.9424	3.0516	2.7385	2.9724	3.7813	5.7614	8.3924	10.9477	12.0576	11.1298	20.00 Y
Z	9.00											9.00 Z
Y	15.00	3.8248	2.6899	2.3233	2.5924	3.6123	5.7225	10.3356	15.8636	18.6345	16.2345	15.00 Y
Z	9.00											9.00 Z
Y	10.00	3.2084	1.9900	1.6345	1.8559	2.9823	5.6457	12.0328	24.0670	32.8967	24.9452	10.00 Y
Z	9.00											9.00 Z
Y	5.00	1.6694	.9169	.7363	.8939	1.5310	3.5138	10.1002	31.3713	58.0246	32.9276	5.00 Y
Z	9.00											9.00 Z
Y	-.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y
Z	9.00											9.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	9.00											9.00 Z

TEST HOE 1X 180 LP HOUV 80 FT SPACING 15 FT HTG H150 V90

TEST GRID 3 COORDINATES OF CENTER X 105.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 130.00	X 135.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y	55.00	2.8728	2.8991	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	50.00	3.1716	3.1586	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	45.00	3.5954	3.4632	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	40.00	4.1447	3.9001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	35.00	4.8650	4.4345	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	30.00	5.8239	5.0380	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.
Z	9.00											0.
Y	25.00	7.0921	5.6339	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	20.00	8.8011	6.0387	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	15.00	10.7993	6.0882	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	10.00	12.8180	6.0756	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	5.00	10.8696	3.8550	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z

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00100 0000                                 70
00110      TEST 80F  1X 180 LP WGQV      80 FT SPACING  15 FT MTG H150 V90
00120      LP180WGQV          1.00      0.85       1.00
00130      9999999999
00140      LP180WGQV          0.00      0.00      15.00      90.00      20.00
00150      LP180WGQV         70.00      0.00      15.00      90.00      20.00
00160      LP180WGQV        140.00      0.00      15.00      90.00      20.00
00170      LP180WGQV        210.00      0.00      15.00      90.00      20.00
00180      LP180WGQV        280.00      0.00      15.00      90.00      20.00
00190      9999999999
00200          120.00        22.50      0.00       0.00       0.00
00210            5.00         5.00        12         13          V     270.00
00220          120.00        22.50      3.00       0.00       0.00
00230            5.00         5.00        12         13          V     270.00
00240          120.00        22.50      9.00       0.00       0.00
00250            5.00         5.00        12         13          V     270.00
00260      9999999999
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70

TEST ROF 1X 180 LP WGGV 90 FT SPACING 15 FT MTG H150 V90

TEST GRID 1 COORDINATES OF CENTER X 120.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	X 130.00	X 135.00	X 140.00	
Y 55.00 Z 0.00	2.0233	2.0056	1.9996	2.0108	2.0311	2.0484	2.0822	2.1284	2.1687	2.1808	55.00 Y 0.00 Z
Y 50.00 Z 0.00	2.1049	2.0651	2.0690	2.0672	2.1118	2.1784	2.2752	2.3578	2.4178	2.4382	50.00 Y 0.00 Z
Y 45.00 Z 0.00	2.2155	2.1266	2.0892	2.1223	2.2099	2.3665	2.5070	2.6370	2.7284	2.7628	45.00 Y 0.00 Z
Y 40.00 Z 0.00	2.3595	2.1887	2.1305	2.1773	2.3402	2.5602	2.7789	2.9796	3.1202	3.1770	40.00 Y 0.00 Z
Y 35.00 Z 0.00	2.4988	2.2671	2.1557	2.2471	2.4622	2.7585	3.0947	3.3970	3.6184	3.7111	35.00 Y 0.00 Z
Y 30.00 Z 0.00	2.6059	2.3086	2.2093	2.2775	2.5511	2.9630	3.4421	3.9113	4.3005	4.4656	30.00 Y 0.00 Z
Y 25.00 Z 0.00	2.7323	2.3096	2.1818	2.2724	2.5923	3.1511	3.8591	4.6455	5.3036	5.5885	25.00 Y 0.00 Z
Y 20.00 Z 0.00	2.6311	2.1820	2.0237	2.1435	2.5493	3.2249	4.2375	5.4739	6.6146	7.1281	20.00 Y 0.00 Z
Y 15.00 Z 0.00	2.3293	1.8580	1.6893	1.8242	2.2467	3.0444	4.3434	6.2429	8.1822	9.0840	15.00 Y 0.00 Z
Y 10.00 Z 0.00	1.7336	1.3178	1.1697	1.2748	1.6388	2.4094	3.8422	6.0850	8.2561	9.2386	10.00 Y 0.00 Z
Y 5.00 Z 0.00	.8542	.6125	.5402	.6038	.8194	1.2891	2.2753	3.7383	5.2965	0.0000	5.00 Y 0.00 Z
Y -.00 Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 0.00 Z
Y -5.00 Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 0.00 Z

TEST GRID 1 COORDINATES OF CENTER X 120.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 145.00	X 150.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y 55.00 Z 0.00	2.1724	2.1366	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 50.00 Z 0.00	2.4242	2.3705	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 45.00 Z 0.00	2.7388	2.6569	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 40.00 Z 0.00	3.1382	3.0112	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 35.00 Z 0.00	3.6479	3.4451	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 30.00 Z 0.00	4.3469	3.9875	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 25.00 Z 0.00	5.3735	4.7576	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 20.00 Z 0.00	6.7168	5.6323	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 15.00 Z 0.00	8.2984	6.4474	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 10.00 Z 0.00	8.3965	6.3249	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y 5.00 Z 0.00	5.3499	3.8470	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y .00 Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y -5.00 Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

TEST GRID 2 COORDINATES OF CENTER X 120.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	X 130.00	X 135.00	X 140.00	
Y 55.00	Z 3.00	2.1671	2.1528	2.1459	2.1563	2.1590	2.1718	2.2063	2.2598	2.3024	2.3184	55.00 Y 3.00 Z
Y 50.00	Z 3.00	2.2667	2.2243	2.2387	2.2147	2.2515	2.3090	2.4111	2.4991	2.5632	2.5864	50.00 Y 3.00 Z
Y 45.00	Z 3.00	2.3525	2.2791	2.2428	2.2611	2.3290	2.4963	2.6466	2.7878	2.8864	2.9228	45.00 Y 3.00 Z
Y 40.00	Z 3.00	2.4598	2.2846	2.2189	2.2618	2.4324	2.6740	2.9376	3.1794	3.3462	3.4117	40.00 Y 3.00 Z
Y 35.00	Z 3.00	2.5621	2.2950	2.1625	2.2714	2.5221	2.8876	3.3160	3.6912	3.9626	4.0733	35.00 Y 3.00 Z
Y 30.00	Z 3.00	2.6493	2.2927	2.1891	2.2593	2.5895	3.1067	3.7411	4.3391	4.7938	4.9828	30.00 Y 3.00 Z
Y 25.00	Z 3.00	2.8934	2.2966	2.1588	2.2548	2.5970	3.2912	4.2031	5.1556	5.9255	6.2835	25. 3.0
Y 20.00	Z 3.00	2.6695	2.1784	2.0052	2.1323	2.5730	3.4091	4.7061	6.2843	7.7712	8.4501	20.00 Y 3.00 Z
Y 15.00	Z 3.00	2.4200	1.8597	1.6730	1.8168	2.3248	3.3491	5.0027	7.4773	10.2548	11.6539	15.00 Y 3.00 Z
Y 10.00	Z 3.00	1.8328	1.3171	1.1505	1.2661	1.7267	2.7078	4.5356	7.9584	12.4602	14.6142	10.00 Y 3.00 Z
Y 5.00	Z 3.00	.8911	.6013	.5212	.5958	.6623	1.4395	2.7489	5.5384	9.2248	0.0000	5.00 Y 3.00 Z
Y .00	Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 3.00 Z
Y -5.00	Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 3.00 Z

TEST GRID 2 COORDINATES OF CENTER X 120.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X	X	X	X	X	X	X	X	X	X	
		145.00	150.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Y	55.00	2.3125	2.2794	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	50.00	2.5737	2.5205	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	45.00	2.8964	2.8101	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	40.00	3.3631	3.2114	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	35.00	3.9918	3.7405	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	30.00	4.8437	4.4171	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	25.00	6.0127	5.2877	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	20.00	7.9106	6.4883	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	15.00	10.4624	7.7735	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	10.00	12.7309	8.3457	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	5.00	9.3954	5.8045	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z

TEST ROF 1X 180 LP WGOV 80 FT SPACING 15 FT MTG H150 V90

TEST GRID 3 COORDINATES OF CENTER X 120.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	X 130.00	X 135.00	X 140.00	
Y 55.00	Z 9.00	2.4482	2.4460	2.4371	2.4261	2.4049	2.4077	2.4469	2.5168	2.5705	2.5977	55.00 Y 9.00 Z
Y 50.00	Z 9.00	2.5867	2.5387	2.5782	2.5033	2.5225	2.5838	2.7181	2.8353	2.9197	2.9600	50.00 Y 9.00 Z
Y 45.00	Z 9.00	2.7092	2.6097	2.5372	2.5551	2.6223	2.8425	3.0484	3.2417	3.3767	3.4384	45.00 Y 9.00 Z
Y 40.00	Z 9.00	2.8831	2.5727	2.4237	2.5055	2.7843	3.1163	3.4559	3.7733	3.9925	4.0908	40.00 Y 9.00 Z
Y 35.00	Z 9.00	3.0111	2.4849	2.2154	2.4358	2.9008	3.3895	3.9662	4.4777	4.8486	5.0099	35.00 Y 9.00 Z
Y 30.00	Z 9.00	2.9083	2.2953	2.1707	2.2677	2.8098	3.6519	4.5492	5.4155	6.0769	6.3569	30.00 Y 9.00 Z
Y 25.00	Z 9.00	2.7294	2.2078	2.0388	2.1629	2.5821	3.6708	5.1226	6.6737	7.8928	8.4084	25.00 Y 9.
Y 20.00	Z 9.00	2.5768	2.0081	1.8146	1.9483	2.4547	3.4311	5.5124	8.2017	10.7883	11.9099	20.00 Y 9.00 Z
Y 15.00	Z 9.00	2.2937	1.6683	1.4595	1.6043	2.1541	3.3295	5.5272	10.1873	15.7398	18.5224	15.00 Y 9.00 Z
Y 10.00	Z 9.00	1.7141	1.1426	.9895	1.0980	1.5716	2.7802	5.5126	11.9369	23.9977	32.8335	10.00 Y 9.00 Z
Y 5.00	Z 9.00	.7883	.5033	.4321	.5053	.7720	1.4612	3.4714	10.0428	31.3303	58.0244	5.00 Y 9.00 Z
Y -.00	Z 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 9.00 Z
Y -5.00	Z 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 9.00 Z

TEST GRID 3 COORDINATES OF CENTER X 120.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 145.00	X 150.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y	55.00	2.5954	2.5605	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	50.00	2.9506	2.8897	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	45.00	3.4155	3.3113	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	40.00	4.0447	3.8654	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	35.00	4.9187	4.6008	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	30.00	6.1731	5.5786	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	25.00	8.0213	6.8774	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	20.00	10.9759	8.4216	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	15.00	16.1201	10.6648	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	10.00	24.8786	12.7271	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	5.00	32.8773	10.8006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	9.00											0.00 Z

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00100 0000
00110      TEST 81    2X180WGQV    100 FT SPACING 15 FT MTG
00120      LP180WGQV        1.00        0.85        1.00
00130      9999999999
00140      LP180WGQV        0.00        0.00       15.00       90.00       20.00
00150      LP180WGQV        0.00        0.00       15.00       90.00       20.00
00160      LP180WGQV      100.00        0.00       15.00       90.00       20.00
00170      LP180WGQV      100.00        0.00       15.00       90.00       20.00
00180      LP180WGQV      200.00        0.00       15.00       90.00       20.00
00190      LP180WGQV      200.00        0.00       15.00       90.00       20.00
00200      LP180WGQV      300.00        0.00       15.00       90.00       20.00
00210      LP180WGQV      300.00        0.00       15.00       90.00       20.00
00220      LP180WGQV      400.00        0.00       15.00       90.00       20.00
00230      LP180WGQV      400.00        0.00       15.00       90.00       20.00
00240      9999999999
00250          175.00      22.50        0.00        0.00        0.00
00260            5.00       5.00          12          12           V      270.00
00270          175.00      22.50        3.00        0.00        0.00
00280            5.00       5.00          12          12           V      270.00
00290          175.00      22.50        9.00        0.00        0.00
00300            5.00       5.00          12          12           V      270.00
00310      9999999999
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TEST A1 2X180WGQV 100 FT SPACING 15 FT MTG

TEST GRID 1 COORDINATES OF CENTER X 175.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 150.00	X 155.00	X 130.00	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	Y 195.00	
Y Z	52.50 0.00	2.1762	2.2266	2.3692	2.5576	2.7739	3.0415	3.2740	3.5155	3.7061	3.8418	52.50 Y 0.00 Z
Y Z	47.50 0.00	2.1494	2.2014	2.3574	2.5882	2.8651	3.2298	3.6054	3.9364	4.2145	4.4057	47.50 Y 0.00 Z
Y Z	42.50 0.00	2.1505	2.1793	2.3206	2.5916	2.9878	3.4518	3.9846	4.4422	4.8469	5.1225	42.50 Y 0.00 Z
Y Z	37.50 0.00	2.1189	2.1544	2.2934	2.5952	3.0742	3.6823	4.3678	5.0471	5.6347	6.0392	37.50 Y 0.00 Z
Y Z	32.50 0.00	2.0416	2.0877	2.2663	2.5922	3.1268	3.8900	4.7940	5.7568	6.5936	7.2123	32.50 Y 0.00 Z
Y Z	27.50 0.00	1.9043	1.9591	2.1689	2.5535	3.1574	4.0599	5.2489	6.5627	7.9118	8.9844	27.50 Y 0.00 Z
Y Z	22.50 0.00	1.6866	1.7413	1.9653	2.3995	3.1065	4.1746	5.6423	7.5139	9.5982	11.3704	22.50 Y 0.00 Z
Y Z	17.50 0.00	1.3494	1.4106	1.6440	2.0911	2.8334	4.0050	5.7081	8.1741	11.3576	14.4423	17.50 Y 0.00 Z
Y Z	12.50 0.00	.9370	.9731	1.1731	1.5560	2.2499	3.3504	5.1256	8.0632	12.5041	16.7904	12.50 Y 0.00 Z
Y Z	7.50 0.00	.5230	.5594	.6833	.9291	1.3694	2.1433	3.5585	6.2392	10.1755	14.2157	7.50 Y 0.00 Z
Y Z	2.50 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	.7170	1.2445	2.3141	3.9682	0.0000	2.50 Y 0.00 Z
Y Z	-2.50 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-2.50 Y 0.00 Z

TEST 81 2X180WGQV 100 FT SPACING 15 FT MTG

TEST GRID 1 COORDINATES OF CENTER X 175.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 200.00	X 205.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00		
Y	52.50	3.8878	3.8571	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z
Y	47.50	4.4759	4.4295	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z
Y	42.50	5.2302	5.1589	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z
Y	37.50	6.2057	6.0955	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z
Y	32.50	7.4724	7.2995	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z
Y	27.50	9.5412	9.1089	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z
Y	22.50	12.1441	11.5514	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	Y
Z	0.00											0.00	Z
Y	17.50	15.8318	14.6731	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z
Y	12.50	18.6550	17.0605	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z
Y	7.50	15.8055	14.4463	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z
Y	2.50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z
Y	-2.50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	Y
Z	0.00											0.00	Z

TEST GRID 2 COORDINATES OF CENTER X 175.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 150.00	X 155.00	X 160.00	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	X 195.00	
Y 52.50 Z 3.00	2.2177	2.2816	2.4644	2.6989	2.9446	3.2469	3.5140	3.7742	3.9784	4.1236	52.50 Y 3.00 Z
Y 47.50 Z 3.00	2.1627	2.2301	2.4300	2.7315	3.0690	3.4547	3.8572	4.2129	4.5128	4.7184	47.50 Y 3.00 Z
Y 42.50 Z 3.00	2.1459	2.1817	2.3578	2.6985	3.1612	3.6503	4.2337	4.7276	5.1924	5.5097	42.50 Y 3.00 Z
Y 37.50 Z 3.00	2.0919	2.1350	2.2924	2.6233	3.1542	3.8083	4.6170	5.4363	6.1398	6.6173	37.50 Y 3.00 Z
Y 32.50 Z 3.00	1.9932	2.0436	2.2315	2.5610	3.1152	3.9960	5.0842	6.3046	7.3369	8.1014	32.50 Y 3.00 Z
Y 27.50 Z 3.00	1.8380	1.8956	2.1117	2.5024	3.1274	4.1245	5.5652	7.2403	8.8683	10.1042	27.50 Y 3.00 Z
Y 22.50 Z 3.00	1.6113	1.6726	1.9080	2.3538	3.0884	4.2231	5.9731	8.3179	10.8563	13.1018	22.50 Y 3.00 Z
Y 17.50 Z 3.00	1.2887	1.3515	1.5938	2.0524	2.8278	4.1344	6.2455	9.3321	13.4164	17.5023	17.50 Y 3.00 Z
Y 12.50 Z 3.00	.8918	.9290	1.1308	1.5222	2.2494	3.5576	5.7745	9.4796	15.5172	23.0789	12.50 Y 3.00 Z
Y 7.50 Z 3.00	.4928	.5325	.6562	.9046	1.3716	2.2933	4.0447	7.5088	14.4916	23.3640	7.50 Y 3.00 Z
Y 2.50 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	.7676	1.4009	2.8165	5.9114	0.0000	2.50 Y 3.00 Z
Y -2.50 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-2.50 Y 3.00 Z

TEST GRID 2 COORDINATES OF CENTER X 175.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 200.00	X 205.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y	52.50	4.1778	4.1502	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	47.50	4.7945	4.7471	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	42.50	5.6307	5.5444	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	37.50	6.8097	6.6728	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	32.50	8.4144	8.1907	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	27.50	10.6272	10.2488	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	22.50	14.1034	13.3316	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.[illegible] Y
Z	3.00											0.[illegible]
Y	17.50	19.4361	17.8478	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	12.50	27.0351	23.5409	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	7.50	27.8256	23.9099	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	2.50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z
Y	-2.50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y
Z	3.00											0.00 Z

TEST A1 2X180WGQV 100 FT SPACING 15 FT MTG PAGE 10

TEST GRID 3 COORDINATES OF CENTER X 175.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 150.00	X 155.00	X 160.00	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	X 195.00	
Y	52.50	2.2664	2.3666	2.6389	2.9732	3.2821	3.6570	3.9922	4.3173	4.5740	4.7536	52.50 Y
Z	9.00											9.00 Z
Y	47.50	2.1545	2.2571	2.5519	3.0058	3.4708	3.9574	4.4672	4.9241	5.3106	5.5748	47.50 Y
Z	9.00											9.00 Z
Y	42.50	2.0936	2.1449	2.3968	2.9050	3.6315	4.2751	5.0280	5.6840	6.2719	6.6707	42.50 Y
Z	9.00											9.00 Z
Y	37.50	1.9863	2.0437	2.2485	2.7142	3.5398	4.5899	5.5965	6.6396	7.5505	8.1707	37.50 Y
Z	9.00											9.00 Z
Y	32.50	1.8368	1.8943	2.1202	2.5330	3.3194	4.6579	6.1988	7.8323	9.2312	10.2783	32.50 Y
Z	9.00											9.00 Z
Y	27.50	1.6395	1.6972	1.9254	2.3797	3.1105	4.4326	6.6570	9.0528	11.4851	13.3280	27.50 Y
Z	9.00											9.00 Z
Y	22.50	1.3868	1.4446	1.6785	2.1353	2.9212	4.1963	6.5047	10.2497	14.4494	17.8572	22.50 Y
Z	9.00											9.00 Z
Y	17.50	1.0984	1.1459	1.3512	1.7817	2.5624	3.9321	6.2958	10.6313	17.9650	25.6635	17.50 Y
Z	9.00											9.00 Z
Y	12.50	.7506	.7788	.9504	1.2973	1.9739	3.2973	5.8862	11.0724	22.0747	38.2587	12.50 Y
Z	9.00											9.00 Z
Y	7.50	.4081	.4385	.5423	.7581	1.1816	2.0830	4.1994	9.5671	24.0335	58.0035	7.50 Y
Z	9.00											9.00 Z
Y	2.50	0.0000	0.0000	0.0000	0.0000	0.0000	.6879	1.4306	3.5427	10.9699	44.3069	2.50 Y
Z	9.00											9.00 Z
Y	-2.50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-2.50 Y
Z	9.00											9.00 Z

TEST 81 2X1000WSQV 100 FT SPACING 15 FT MTG

TEST GRID 3 COORDINATES OF CENTER X 175.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 200.00	X 205.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	X 0.00	
Y Z	52.50 9.00	4.8364	4.8145	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y Z	47.50 9.00	5.4948	5.6545	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y Z	42.50 9.00	6.8494	6.7762	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y Z	37.50 9.00	8.4461	8.3094	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y Z	32.50 9.00	10.7255	10.4624	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y Z	27.50 9.00	14.1031	13.5698	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.0
Y Z	22.50 9.00	19.3189	18.1547	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y Z	17.50 9.00	29.1339	26.1866	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y Z	12.50 9.00	47.6856	39.4498	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y Z	7.50 9.00	91.7065	60.4895	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y Z	2.50 9.00	0.0000	46.4362	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z
Y Z	-2.50 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00 Y 0.00 Z

00100	0000					
00110	TEST 91F 1X HP250		SPACING 30 FT MTG			
00120	HS250GITT	0.85	0.85	1.00		
00130	9999999999					
00140	HS250GITT	0.00	0.00	30.00	90.00	10.0
00150	HS250GITT	40.00	0.00	30.00	90.00	10.0
00160	HS250GITT	80.00	0.00	30.00	90.00	10.0
00170	HS250GITT	120.00	0.00	30.00	90.00	10.0
00180	HS250GITT	160.00	0.00	30.00	90.00	10.0
00190	9999999999					
00200	105.00	22.50	0.00	0.00	0.00	
00210	3.00	5.00	10	13	V	270.0
00220	105.00	22.50	3.00	0.00	0.00	
00230	3.00	5.00	10	13	V	270.0
00240	105.00	22.50	9.00	0.00	0.00	
00250	3.00	5.00	10	13	V	270.0
00260	9999999999					

TEST 91E 1X HP250 60 SPACING 30 FT MTG PAGE 4

TEST GRID 1 COORDINATES OF CENTER X 105.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 93.00	X 96.00	X 99.00	X 102.00	X 105.00	X 108.00	X 111.00	X 114.00	X 117.00	X 120.00	
Y	55.00	1.7283	2.1070	2.5994	3.0520	3.2781	2.9742	2.3672	1.9849	1.7059	1.5353	55.00 Y
Z	0.00											0.00 Z
Y	50.00	1.9861	2.3255	2.5737	2.8686	2.9609	2.6004	2.2424	1.9500	1.7504	1.5742	50.00 Y
Z	0.00											0.00 Z
Y	45.00	2.0289	2.0867	2.1937	2.4651	2.5155	2.4098	2.2083	2.0432	1.8733	1.6961	45.00 Y
Z	0.00											0.00 Z
Y	40.00	1.7397	1.7869	2.0847	2.3738	2.5189	2.4996	2.3743	2.2327	2.0441	1.8515	40.00 Y
Z	0.00											0.00 Z
Y	35.00	1.7784	2.0587	2.3397	2.6258	2.7911	2.6888	2.5558	2.4225	2.1982	1.8930	35.00 Y
Z	0.00											0.00 Z
Y	30.00	1.9284	2.2051	2.4895	2.7343	2.8700	2.8628	2.6930	2.4302	2.2029	1.8841	30.00 Y
Z	0.00											0.00 Z
Y	25.00	1.9090	2.3031	2.5765	2.7636	2.9665	2.8879	2.6552	2.3782	2.2211	1.9439	25 Y
Z	0.00											0.00 Z
Y	20.00	1.6482	2.0778	2.3765	2.5906	2.6601	2.61-8	2.4377	2.1213	1.7453	1.3931	20.00 Y
Z	0.00											0.00 Z
Y	15.00	1.3306	1.8338	2.2803	2.5181	2.5739	2.5107	2.2452	1.8193	1.4655	1.1587	15.00 Y
Z	0.00											0.00 Z
Y	10.00	.8104	1.1632	1.5745	1.8521	2.0271	1.9890	1.6742	1.2199	.9647	.8995	10.00 Y
Z	0.00											0.00 Z
Y	5.00	.3216	.4555	.5972	.7232	.8460	.8380	.7668	.6212	.4914	.1554	5.00 Y
Z	0.00											0.00 Z
Y	0.00	.0000	.0000	.0000	.0500	.0000	.0000	.0[illegible]	[illegible]	.0000	.0000	0.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST GRID 2 COORDINATES OF CENTER X 105.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 93.00	X 96.00	X 99.00	X 102.00	X 105.00	X 108.00	X 111.00	X 114.00	X 117.00	X 120.00	
Y	55.00	1.9290	2.4721	3.2104	3.8350	3.7599	3.1683	2.4613	2.0211	1.6667	1.4743	55.00 Y
Z	3.00											3.00 Z
Y	50.00	2.1306	2.7330	3.4713	3.8879	3.6134	2.8104	2.2784	1.9083	1.6934	1.5967	50.00 Y
Z	3.00											3.00 Z
Y	45.00	2.4681	2.8057	3.2386	3.5360	3.1069	2.6117	2.2249	1.9947	1.8073	1.6222	45.00 Y
Z	3.00											3.00 Z
Y	40.00	2.2681	2.3760	2.7502	2.9107	2.8166	2.5959	2.4176	2.1809	1.9294	1.7061	40.00 Y
Z	3.00											3.00 Z
Y	35.00	1.9323	2.2116	2.7013	2.9817	3.0253	2.8778	2.7076	2.4334	2.0802	1.7898	35.00 Y
Z	3.00											3.00 Z
Y	30.00	2.1758	2.5715	3.0289	3.3166	3.3072	3.1442	2.8633	2.4796	2.1357	1.7978	30.00 Y
Z	3.00											3.00 Z
Y	25.00	2.3149	2.8026	3.1923	3.4481	3.5417	3.1779	2.7767	2.4218	2.2133	2.0242	25.00 Y
Z	3.00											3.00 Z
Y	20.00	2.1802	2.7157	3.1563	3.3094	3.2572	3.0085	2.5937	2.2572	1.9566	1.4824	20.00 Y
Z	3.00											3.00 Z
Y	15.00	1.8573	2.4804	2.9460	3.0526	3.0723	2.7454	2.2372	1.8504	1.5513	1.2262	15.00 Y
Z	3.00											3.00 Z
Y	10.00	1.1174	1.7235	2.3754	2.7652	2.6313	2.1914	1.7127	1.3272	.9838	.8539	10.00 Y
Z	3.00											3.00 Z
Y	5.00	.4712	.6911	.9397	1.1497	1.1622	.9350	.7275	.6388	.5288	.4631	5.00 Y
Z	3.00											3.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y
Z	3.00											3.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	3.00											3.00 Z

TEST GRID 3 COORDINATES OF CENTER X 105.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 93.00	X 96.00	X 99.00	X 102.00	X 105.00	X 108.00	X 111.00	X 114.00	X 117.00	X 120.00	
Y 55.00 Z 9.00	2.7529	4.0018	4.9487	4.7130	3.8330	2.9680	2.2145	1.7699	1.4856	1.3424	55.00 Y 9.00 Z
Y 50.00 Z 9.00	3.2019	4.5113	5.4305	4.8950	3.8095	2.8216	2.1746	1.7196	1.5154	1.4621	50.00 Y 9.00 Z
Y 45.00 Z 9.00	3.6938	5.2762	5.8374	4.8749	3.5420	2.6253	1.9997	1.7738	1.6433	1.6029	45.00 Y 9.00 Z
Y 40.00 Z 9.00	4.2210	5.7607	5.9328	4.3241	3.1282	2.3478	2.0933	1.9201	1.7929	1.7576	40.00 Y 9.00 Z
Y 35.00 Z 9.00	4.3929	5.3007	4.3340	3.7432	2.9753	2.5787	2.2864	2.0842	1.9320	1.7703	35.00 Y 9.00 Z
Y 30.00 Z 9.00	3.2565	4.0401	4.1029	3.7616	3.3974	2.9947	2.5622	2.1849	1.9494	1.8296	3[illegible] Y Z
Y 25.00 Z 9.00	3.5098	4.3406	4.5513	4.4142	4.1358	3.3708	2.6868	2.2224	2.0094	1.8889	25.00 Y 9.00 Z
Y 20.00 Z 9.00	4.0153	4.4809	5.0812	4.5871	3.8995	3.1075	2.6163	2.2699	2.2487	2.3504	20.00 Y 9.00 Z
Y 15.00 Z 9.00	3.8804	4.5072	4.6282	4.2568	3.4831	2.7584	2.3235	2.0715	1.9313	1.6179	15.00 Y 9.00 Z
Y 10.00 Z 9.00	3.5206	4.1390	4.3965	3.8228	2.7591	2.1556	1.6904	1.5179	1.5136	1.2738	10.00 Y 9.00 Z
Y 5.00 Z 9.00	1.4477	2.0164	2.2096	1.8314	1.3449	1.0326	.8368	.6482	.8281	.7657	5.00 Y 9.00 Z
Y -.00 Z 9.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 9.00 Z
Y -5.00 Z 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 9.00 Z

00100	0000					
00110	TEST 33	2X LS90WWNO	100 FT SPACING 15 FT MTG			H140 V90
00120	LS90WWNO	1.00	0.85	1.00		
00130	9999999999					
00140	LS90WWNO	0.00	0.00	15.00	45.00	70.00
00150	LS90WWNO	100.00	0.00	15.00	45.00	70.00
00160	LS90WWNO	100.00	0.00	15.00	135.00	70.00
00170	LS90WWNO	200.00	0.00	15.00	45.00	70.00
00180	LS90WWNO	200.00	0.00	15.00	135.00	70.00
00190	LS90WWNO	300.00	0.00	15.00	45.00	70.00
00200	LS90WWNO	300.00	0.00	15.00	135.00	70.00
00210	LS90WWNO	200.00	0.00	15.00	135.00	70.00
00220	9999999999					
00230	190.00	22.50	0.00	0.00	0.00	
00240	5.00	5.00	20	13	V	270.00
00250	190.00	22.50	3.00	0.00	0.00	
00260	5.00	5.00	20	13	V	270.00
00270	190.00	22.50	9.00	0.00	0.00	
00280	5.00	5.00	20	13	V	270.00
00290	9999999999					

TEST 93 2X LS90WWNO 100 FT SPACING 15 FT MTG H140 V9 PAGE 4

TEST GRID 1 COORDINATES OF CENTER X 190.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 145.00	X 150.00	X 155.00	X 160.00	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	
Y 55.00	Z 0.00	2.5462	2.6252	2.7243	2.7919	2.8866	2.9863	3.0751	3.0840	3.0212	3.1191	55.00 Y 0.00 Z
Y 50.00	Z 0.00	2.6760	2.8918	2.9647	3.0905	3.2581	3.4512	3.6425	3.7454	3.7205	3.8071	50.00 Y 0.00 Z
Y 45.00	Z 0.00	2.7881	2.9273	3.2016	3.4042	3.6755	3.9993	4.3399	4.6296	4.6854	4.7903	45.00 Y 0.00 Z
Y 40.00	Z 0.00	2.7729	2.9158	3.2252	3.7160	4.1245	4.6294	5.1958	5.7623	6.0408	6.2473	40.00 Y 0.00 Z
Y 35.00	Z 0.00	2.7014	2.8415	3.1845	3.7511	4.5720	5.3154	6.2145	6.9957	7.1841	6.7572	35.00 Y 0.00 Z
Y 30.00	Z 0.00	2.5552	2.6881	3.0552	3.6913	4.6489	5.9956	6.3690	7.6732	8.0134	7.5663	30.00 Y 0.00 Z
Y 25.00	Z 0.00	2.3143	2.4362	2.8093	3.4887	4.5698	5.8606	7.3803	8.3080	8.7064	8.1641	25 Y 0.[illegible] Z
Y 20.00	Z 0.00	1.9493	2.0419	2.6105	3.1033	4.1292	5.1846	6.6733	8.8403	9.0076	7.5447	20.00 Y 0.00 Z
Y 15.00	Z 0.00	1.4703	1.5371	1.8353	2.4390	3.1856	4.0683	5.2554	6.7677	7.3067	4.2974	15.00 Y 0.00 Z
Y 10.00	Z 0.00	.9132	.9495	1.1487	1.5759	1.9987	2.5633	3.2888	3.7835	2.8688	3.4602	10.00 Y 0.00 Z
Y 5.00	Z 0.00	.3856	.4011	.4787	.6306	.8131	1.0713	1.3704	1.4215	1.3030	1.7722	5.00 Y 0.00 Z
Y -.00	Z 0.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y 0.00 Z
Y -5.00	Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 0.00 Z

TEST 93 2X LS90WWNO 100 FT SPACING 15 FT MTG M140 V9 PAGE 5

TEST GRID 1 COORDINATES OF CENTER X 190.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 195.00	X 200.00	X 205.00	X 210.00	X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	
Y	55.00	2.9540	3.2273	3.4166	2.5856	1.6867	1.7343	1.7528	1.7397	1.7307	1.7308	55.00 Y
Z	0.00											0.00 Z
Y	50.00	3.5484	3.8632	4.0097	2.9374	2.0273	2.0566	2.0291	1.9660	1.9103	1.8774	50.00 Y
Z	0.00											0.00 Z
Y	45.00	4.3807	4.7248	4.7900	3.3787	2.4984	2.4876	2.3672	2.2293	2.1088	2.0273	45.00 Y
Z	0.00											0.00 Z
Y	40.00	5.4861	5.7855	5.7236	3.9402	3.1624	3.0399	2.7809	2.5293	2.3190	2.1705	40.00 Y
Z	0.00											0.00 Z
Y	35.00	6.3898	6.6606	6.2448	3.4946	3.7181	3.6398	3.2719	2.8532	2.5233	2.1690	35.00 Y
Z	0.00											0.00 Z
Y	30.00	7.3028	7.6288	6.6018	3.8823	4.1151	3.9594	3.6278	3.1700	2.5367	2.1126	30.00 Y
Z	0.00											0.00 Z
Y	25.00	7.7619	8.2813	6.4167	4.1537	4.4426	4.2557	3.8096	3.0750	2.4653	1.9751	25.00 Y
Z	0.00											0.00 Z
Y	20.00	6.0611	6.4397	4.2064	3.8365	4.5741	4.4999	3.4306	2.7068	2.2086	1.7379	20.00 Y
Z	0.00											0.00 Z
Y	15.00	3.9010	4.9730	1.9949	2.1954	3.7046	3.4419	2.6959	2.1172	1.6974	1.3559	15.00 Y
Z	0.00											0.00 Z
Y	10.00	3.5429	4.3694	1.7998	1.7599	1.4671	1.9286	1.6875	1.3337	1.0645	.8722	10.00 Y
Z	0.00											0.00 Z
Y	5.00	2.0567	.0268	1.0417	.8999	.6664	.7273	.7043	.5585	.4350	.3521	5.00 Y
Z	0.00											0.00 Z
Y	.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0600	.0000	.0000	.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST GRID 2 COORDINATES OF CENTER X 190.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 145.00	X 150.00	X 155.00	X 160.00	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	
Y	55.00	2.3301	2.4143	2.5133	2.5770	2.6420	2.7148	2.7718	2.7740	2.7085	2.8935	55.00 Y
Z	3.00											3.00 Z
Y	50.00	2.4936	2.7241	2.7917	2.8828	3.0095	3.1625	3.3072	3.3837	3.3518	3.5232	50.00 Y
Z	3.00											3.00 Z
Y	45.00	2.6251	2.7802	3.0437	3.2085	3.4340	3.7013	3.9810	4.2078	4.2504	4.4270	45.00 Y
Z	3.00											3.00 Z
Y	40.00	2.6090	2.7449	3.0518	3.5395	3.9007	4.3396	4.8257	5.2980	5.5336	5.7759	40.00 Y
Z	3.00											3.00 Z
Y	35.00	2.5178	2.6461	2.9846	3.5500	4.3819	5.0609	5.8626	6.7146	7.4035	7.4628	35.00 Y
Z	3.00											3.00 Z
Y	30.00	2.3566	2.4791	2.8328	3.4602	4.4238	5.8122	7.0629	8.5400	10.0480	10.0586	30.00 Y
Z	3.00											3.00 Z
Y	25.00	2.1116	2.2203	2.5771	3.2386	4.3085	5.9345	8.3079	10.4061	11.6712	11.8044	25.
Z	3.00											3.00 Z
Y	20.00	1.7668	1.8494	2.1914	2.8514	3.9573	5.7564	8.3494	11.2889	13.0493	13.2563	20.00 Y
Z	3.00											3.00 Z
Y	15.00	1.3284	1.3874	1.6640	2.2332	3.2714	5.0815	7.0323	9.7982	14.2129	12.3868	15.00 Y
Z	3.00											3.00 Z
Y	10.00	.8396	.8723	1.0550	1.4500	2.1979	3.3930	4.7443	6.6388	8.2613	6.1142	10.00 Y
Z	3.00											3.00 Z
Y	5.00	.3682	.3829	.4572	.6157	.9218	1.3946	2.0071	2.7611	2.8207	2.9339	5.00 Y
Z	3.00											3.00 Z
Y	.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y
Z	3.00											3.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	3.00											3.00 Z

TEST 93 2X LS90WWNO 100 FT SPACING 15 FT MTG H140 V9 PAGE 8

TEST GRID 2 COORDINATES OF CENTER X 190.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 195.00	X 200.00	X 205.00	X 210.00	X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	
Y	55.00	2.8379	3.0869	3.2461	2.3606	1.5100	1.5567	1.5756	1.5742	1.5733	1.5867	55.00 Y
Z	3.00											3.00 Z
Y	50.00	3.4139	3.7138	3.8151	2.6637	1.8237	1.8542	1.8367	1.7928	1.7544	1.7411	50.00 Y
Z	3.00											3.00 Z
Y	45.00	4.2238	4.5737	4.5684	3.0378	2.2630	2.2565	2.1644	2.0538	1.9595	1.9001	45.00 Y
Z	3.00											3.00 Z
Y	40.00	5.4108	5.7890	5.5912	3.5046	2.8925	2.7893	2.5743	2.3606	2.1814	2.0554	40.00 Y
Z	3.00											3.00 Z
Y	35.00	7.2380	7.5656	7.0196	3.8343	3.8135	3.4829	3.0771	2.7047	2.4048	2.0436	35.00 Y
Z	3.00											3.00 Z
Y	30.00	9.3891	9.4993	8.3370	5.1175	5.1202	4.3788	3.6588	3.0597	2.4027	1.9727	30.00 Y
Z	3.00											3.00 Z
Y	25.00	11.1802	11.3682	8.8534	5.9751	5.9152	5.2935	4.2603	3.0966	2.3164	1.8276	25.00 Y
Z	3.00											3.00 Z
Y	20.00	12.0484	12.2758	8.2295	6.6854	6.5872	5.7156	4.2584	2.9805	2.1079	1.5932	20.00 Y
Z	3.00											3.00 Z
Y	15.00	8.4549	8.5373	4.2671	6.2351	7.1522	4.9511	3.5776	2.6158	1.7303	1.2394	15.00 Y
Z	3.00											3.00 Z
Y	10.00	5.8665	7.6899	2.9586	3.0838	4.1599	3.3527	2.4114	1.7445	1.1593	.8028	10.00 Y
Z	3.00											3.00 Z
Y	5.00	4.3221	1.3924	2.1730	1.4793	1.4237	1.3956	1.0212	.7189	.4881	.3430	5.00 Y
Z	3.00											3.00 Z
Y	.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y
Z	3.00											3.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0030	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	3.00											3.00 Z

TEST 93 2X LS90WWNO 100 FT SPACING 15 FT MTG M140 V9 PAGE 10

TEST GRID 3 COORDINATES OF CENTER X 190.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 145.00	X 150.00	X 155.00	X 160.00	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	
Y 55.00	1.5879	1.6439	1.7109	1.7573	1.8183	1.8796	1.9242	1.9385	1.9042	2.1033	55.00 Y
Z 9.00											9.00 Z
Y 50.00	1.6945	1.8403	1.8938	1.9818	2.0899	2.2087	2.3090	2.3665	2.3531	2.5702	50.00 Y
Z 9.00											9.00 Z
Y 45.00	1.7945	1.8835	2.0881	2.2368	2.4229	2.6261	2.8211	2.9589	2.9950	3.2303	45.00 Y
Z 9.00											9.00 Z
Y 40.00	1.7873	1.8877	2.1211	2.5187	2.8197	3.1600	3.5072	3.7975	3.9413	4.1975	40.00 Y
Z 9.00											9.00 Z
Y 35.00	1.7537	1.8386	2.0981	2.5589	3.2766	3.8326	4.4299	5.0037	5.3846	5.3845	35.00 Y
Z 9.00											9.00 Z
Y 30.00	1.6505	1.7313	2.0013	2.5088	3.3431	4.6420	5.6745	6.7500	7.6434	7.9163	30.00 Y
Z 9.00											9.00 Z
Y 25.00	1.4793	1.5485	1.8183	2.3441	3.2469	4.7624	7.2509	9.1142	10.9696	12.2769	25 Y
Z 9.00											5 Z
Y 20.00	1.2368	1.2916	1.5375	2.0387	2.9425	4.5440	7.3087	11.8566	15.8403	20.1016	20.00 Y
Z 9.00											9.00 Z
Y 15.00	.9337	.9726	1.1707	1.5887	2.3766	3.8619	6.6026	11.8881	22.0257	33.3127	15.00 Y
Z 9.00											9.00 Z
Y 10.00	.6051	.6296	.7602	1.0396	1.5849	2.6670	4.9265	10.0583	22.2109	44.6017	10.00 Y
Z 9.00											9.00 Z
Y 5.00	.2817	.2928	.3537	.4850	.7419	1.2365	2.3242	5.1760	13.1913	26.2973	5.00 Y
Z 9.00											9.00 Z
Y -.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y
Z 9.00											9.00 Z
Y -5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z 9.00											9.00 Z

TEST GRID 3 COORDINATES OF CENTER X 190.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 195.00	X 200.00	X 205.00	X 210.00	X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	
Y 55.00 Z 9.00	2.1673	2.3384	2.4294	1.6969	1.0645	1.0908	1.0968	1.0922	1.0848	1.0841	55.00 Y 9.00 Z
Y 50.00 Z 9.00	2.6644	2.8902	2.9136	1.9011	1.2833	1.2995	1.2844	1.2529	1.2184	1.1971	50.00 Y 9.00 Z
Y 45.00 Z 9.00	3.3752	3.6807	3.5649	2.1165	1.5969	1.5886	1.5337	1.4555	1.3799	1.3217	45.00 Y 9.00 Z
Y 40.00 Z 9.00	4.4333	4.8602	4.4594	2.3082	2.0614	1.9992	1.8680	1.7138	1.5702	1.4556	40.00 Y 9.00 Z
Y 35.00 Z 9.00	6.0872	6.7090	5.7088	2.7674	2.7733	2.5920	2.3184	2.0386	1.7867	1.4639	35.00 Y 9.00 Z
Y 30.00 Z 9.00	8.6094	9.3984	7.3263	4.0229	3.8917	3.4534	2.9279	2.4291	1.8041	1.4216	30.00 Y 9.00 Z
Y 25.00 Z 9.00	13.0585	13.8927	9.6344	6.1921	5.5432	4.6226	3.7016	2.4727	1.7368	1.3166	25.00 Y 9.00 Z
Y 20.00 Z 9.00	22.2283	22.3496	13.1557	10.0931	7.9661	5.9801	3.7147	2.3450	1.5623	1.1366	20.00 Y 9.00 Z
Y 15.00 Z 9.00	39.5688	37.3890	19.8140	16.6873	11.0465	5.9820	3.3457	1.9847	1.2555	.8812	15.00 Y 9.00 Z
Y 10.00 Z 9.00	52.5935	50.7095	26.3157	22.3207	11.1271	5.0535	2.4918	1.3680	.8357	.5758	10.00 Y 9.00 Z
Y 5.00 Z 9.00	24.2560	30.5766	12.1370	13.1579	6.6057	2.5992	1.1751	.6340	.3907	.2685	5.00 Y 9.00 Z
Y .00 Z 9.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 9.00 Z
Y -5.00 Z 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 9.00 Z

00100	0000						
00110	TEST 94	2X LP180WMSE	120 FT SPACING 15 FT MTG				M140 V
00120	LP180WMSE	1.00	0.69	1.00			
00130	9999999999						
00140	LP180WMSE	0.00	0.00	15.00	45.00	70.00	
00150	LP180WMSE	120.00	0.00	15.00	45.00	70.00	
00160	LP180WMSE	120.00	0.00	15.00	135.00	70.00	
00170	LP180WMSE	240.00	0.00	15.00	45.00	70.00	
00180	LP180WMSE	240.00	0.00	15.00	135.00	70.00	
00190	LP180WMSE	360.00	0.00	15.00	45.00	70.00	
00200	LP180WMSE	360.00	0.00	15.00	135.00	70.00	
00210	LP180WMSE	480.00	0.00	15.00	135.00	70.00	
00220	9999999999						
00230	210.00	22.50	0.00	0.00	0.00		
00240	5.00	5.00	20	13	V	270.00	
00250	210.00	22.50	1.00	0.00	0.00		
00260	5.00	5.00	20	13	V	270.00	
00270	210.00	22.50	0.00	0.00	0.00		
00280	5.00	5.00	20	13	V	270.00	
00290	9999999999						

TEST 96. 2X LP180WHSE 120 FT SPACING 15 FT MTG M140 Y

TEST GRID 1 COORDINATES OF CENTER X 210.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	X 195.00	X 200.00	X 205.00	X 210.00	
Y	55.00	1.5577	1.4222	1.3248	1.3053	1.3305	1.4236	1.5597	1.7394	2.2170	2.6515	55.00 Y
Z	0.00											0.00 Z
Y	50.00	1.7218	1.5626	1.4617	1.4102	1.4423	1.5437	1.7229	1.9639	2.4830	3.0524	50.00 Y
Z	0.00											0.00 Z
Y	45.00	1.8878	1.6665	1.5432	1.5028	1.5438	1.6677	1.8896	2.2085	2.6214	3.5072	45.00 Y
Z	0.00											0.00 Z
Y	40.00	2.0469	1.7777	1.6228	1.5723	1.6233	1.7788	2.0485	2.4621	3.0158	3.7212	40.00 Y
Z	0.00											0.00 Z
Y	35.00	2.1879	1.8549	1.6659	1.6050	1.6663	1.8558	2.1493	2.7006	3.4260	4.3954	35.00 Y
Z	0.00											0.00 Z
Y	30.00	2.2651	1.8706	1.6557	1.5866	1.6561	1.8714	2.2662	2.8871	3.8098	5.1076	30.00 Y
Z	0.00											0.00 Z
Y	25.00	2.2481	1.8041	1.5604	1.4791	1.5607	1.8048	2.2490	2.9689	4.0859	5.2545	25.00 Y
Z	0.00											0.00 Z
Y	20.00	2.0873	1.6100	1.3604	1.2829	1.3607	1.6105	2.0877	2.8716	4.0092	5.2012	20.00 Y
Z	0.00											0.00 Z
Y	15.00	1.7162	1.2990	1.0846	.9953	1.0559	1.2759	1.7020	2.4447	3.3694	4.5236	15.00 Y
Z	0.00											0.00 Z
Y	10.00	1.0085	.7230	.6088	.6013	.6818	.8622	1.1862	1.7467	2.3581	3.2760	10.00 Y
Z	0.00											0.00 Z
Y	5.00	.2297	.2094	.2189	.2570	.3217	.4251	.5968	.8668	1.1696	1.6392	5.00 Y
Z	0.00											0.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST 94 2X LP180WHSE 120 FT SPACING 15 FT HTS H140 V PAGE 5

TEST GRID 1 COORDINATES OF CENTER X 210.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	X 245.00	X 250.00	X 255.00	X 260.00	
Y	55.00	3.1555	3.4681	4.1915	3.8980	3.3413	4.2454	5.0568	4.6653	4.1915	3.4682	55.00 Y
Z	0.00											0.00 Z
Y	50.00	3.7410	4.4812	5.2330	5.0393	4.0821	5.3320	6.5290	5.9407	5.2330	4.4812	50.00 Y
Z	0.00											0.00 Z
Y	45.00	4.4406	5.5283	6.6300	6.0060	5.1848	6.8588	8.6174	7.7049	6.6300	5.5283	45.00 Y
Z	0.00											0.00 Z
Y	40.00	5.2631	6.8327	8.5190	9.6614	6.9908	8.3625	11.3470	10.1847	8.5190	6.7748	40.00 Y
Z	0.00											0.00 Z
Y	35.00	5.6318	8.1822	10.0222	11.8710	10.0610	11.6251	13.4754	11.8710	10.0222	7.9854	35.00 Y
Z	0.00											0.00 Z
Y	30.00	6.2725	8.6496	11.0396	13.7113	14.2653	15.5021	16.0973	13.7113	11.0156	8.4151	30.
Z	0.00											0.
Y	25.00	5.7185	7.6588	11.7820	15.3683	18.8615	19.9512	18.8616	15.3684	11.9221	7.6589	25.00 Y
Z	0.00											0.00 Z
Y	20.00	6.1434	5.0140	10.0060	14.1739	17.0836	17.9918	17.0833	14.2840	10.0060	5.0140	20.00 Y
Z	0.00											0.00 Z
Y	15.00	6.1980	7.5131	6.0146	9.7121	12.6475	13.8388	12.6475	10.1518	6.0146	7.5131	15.00 Y
Z	0.00											0.00 Z
Y	10.00	4.6505	5.7561	5.9494	6.3235	6.9911	8.2958	7.0029	6.3235	5.9493	5.7561	10.00 Y
Z	0.00											0.00 Z
Y	5.00	2.3568	2.7526	2.8573	2.7906	2.8405	3.2848	2.8405	2.8187	2.8573	2.7526	5.00 Y
Z	0.00											0.00 Z
Y	.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST GRID 2 COORDINATES OF CENTER X 210.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	X 195.00	X 200.00	X 205.00	X 210.00		
Y 55.00	Z 3.00	1.2607	1.1930	1.1530	1.1395	1.1536	1.1943	1.2626	1.3588	1.7310	2.0838	55.00 Y	3.00 Z
Y 50.00	Z 3.00	1.3540	1.2542	1.2013	1.1839	1.2018	1.2553	1.3558	1.5391	1.9406	2.4063	50.00 Y	3.00 Z
Y 45.00	Z 3.00	1.4893	1.3157	1.2384	1.2163	1.2389	1.3168	1.4909	1.7384	2.0655	2.7770	45.00 Y	3.00 Z
Y 40.00	Z 3.00	1.6200	1.3959	1.2587	1.2309	1.2592	1.3969	1.6215	1.9485	2.3949	2.9733	40.00 Y	3.00 Z
Y 35.00	Z 3.00	1.7316	1.4518	1.2835	1.2200	1.2840	1.4526	1.7329	2.1511	2.7459	3.5556	35.00 Y	3.00 Z
Y 30.00	Z 3.00	1.7965	1.4631	1.2698	1.1913	1.2702	1.4638	1.7975	2.3165	3.0858	4.1908	30.00 Y	3.00 Z
Y 25.00	Z 3.00	1.7902	1.4129	1.1950	1.1203	1.1953	1.4134	1.7911	2.3993	3.3474	4.7918	25.00 Y	3.00 Z
Y 20.00	Z 3.00	1.6712	1.2661	1.0443	.9809	1.0445	1.2666	1.6719	2.3398	3.4170	5.1803	20.00 Y	3.00 Z
Y 15.00	Z 3.00	1.3849	1.0272	.8399	.7790	.8379	1.0276	1.3855	2.0154	3.1258	5.0701	15.00 Y	3.00 Z
Y 10.00	Z 3.00	.8616	.6226	.5227	.5133	.5756	.7184	.9825	1.4575	2.3234	3.7662	10.00 Y	3.00 Z
Y 5.00	Z 3.00	.2655	.2303	.2240	.2432	.2865	.3631	.5000	.7491	1.2109	1.9088	5.00 Y	3.00 Z
Y -.00	Z 3.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y	3.00 Z
Y -5.00	Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y	3.00 Z

TEST 94 2X LP180WMSE 120 FT SPACING 15 FT MTG H140 V PAGE 9

TEST GRID 2 COORDINATES OF CENTER X 210.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	X 245.00	X 250.00	X 255.00	X 260.00		
Y	55.00	2.4987	2.9258	3.3668	3.4153	3.2914	3.7264	4.0659	3.7507	3.3658	2.9258	55.00	Y
Z	3.00											3.00	Z
Y	50.00	2.9777	3.5997	4.2392	4.3517	3.9856	4.7023	5.3119	4.8294	4.2392	3.5997	50.00	Y
Z	3.00											3.00	Z
Y	45.00	3.5588	4.4826	5.4310	5.8105	5.0093	6.0950	7.1172	6.3526	5.4310	4.4826	45.00	Y
Z	3.00											3.00	Z
Y	40.00	4.2552	5.6063	7.0804	8.2022	6.6140	8.1483	9.8094	8.5501	7.0804	5.5526	40.00	Y
Z	3.00											3.00	Z
Y	35.00	4.6067	7.0107	9.3787	11.7840	9.3151	11.2899	13.9525	11.7840	9.3787	6.8091	35.00	Y
Z	3.00											3.00	Z
Y	30.00	5.7206	8.7179	12.4934	15.8210	14.0450	15.7425	18.6637	15.8211	12.3886	8.2591	30.00	Y
Z	3.00											3.00	Z
Y	25.00	6.9488	9.5797	14.0371	18.6128	20.9220	22.3481	23.1906	18.6128	13.7629	9.5798	25.00	
Z	3.00											3.00	Z
Y	20.00	7.6786	8.7773	13.1128	20.8912	28.5578	31.0642	28.5578	20.9903	13.1128	8.7772	20.00	Y
Z	3.00											3.00	Z
Y	15.00	7.2564	9.8425	6.9038	18.8462	23.9730	26.0030	23.9729	19.7380	6.9037	9.8424	15.00	Y
Z	3.00											3.00	Z
Y	10.00	5.6056	8.5409	11.5864	11.8829	14.8661	17.0834	15.0168	11.8828	11.5863	8.5408	10.00	Y
Z	3.00											3.00	Z
Y	5.00	2.9096	4.6825	5.5054	5.8450	5.5165	7.3019	5.5165	5.8450	5.5054	4.6824	5.00	Y
Z	3.00											3.00	Z
Y	.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00	Y
Z	3.00											3.00	Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00	Y
Z	3.00											3.00	Z

TEST GRID 3 COORDINATES OF CENTER X 210.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

Y	Z	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	X 195.00	X 200.00	X 205.00	X 210.00	Y	Z
55.00	9.00	.9681	.9230	.8974	.8868	.8979	.9241	.9698	1.0340	1.2546	1.4887	55.00	9.00
50.00	9.00	1.0282	.9669	.9258	.9123	.9263	.9679	1.0297	1.1171	1.3116	1.6003	50.00	9.00
45.00	9.00	1.0849	.9970	.9449	.9280	.9454	.9980	1.0864	1.2023	1.3539	1.7110	45.00	9.00
40.00	9.00	1.1235	1.0147	.9512	.9306	.9516	1.0155	1.1248	1.2843	1.4872	1.7449	40.00	9.00
35.00	9.00	1.1445	1.0132	.9395	.9157	.9399	1.0140	1.1456	1.3423	1.6179	1.9713	35.00	9.00
30.00	9.00	1.1361	.9856	.9027	.8760	.9030	.9862	1.1370	1.3729	1.7181	2.2024	30.00	9.00
25.00	9.00	1.0896	.9219	.8293	.7987	.8296	.9223	1.0904	1.3599	1.7722	2.3899	25.00	9.00
20.00	9.00	.9862	.8081	.7138	.6844	.7140	.8085	.9868	1.2786	1.7406	2.4798	20.00	9.00
15.00	9.00	.8055	.6475	.5654	.5402	.5659	.6482	.8064	1.0813	1.5336	2.3963	15.00	9.00
10.00	9.00	.5682	.4506	.3903	.3718	.3904	.4508	.5687	.7787	1.1531	1.9710	10.00	9.00
5.00	9.00	.2904	.2285	.1971	.1873	.1969	.2282	.2901	.4018	.6056	1.0930	5.00	9.00
-.00	9.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00	9.00
-5.00	9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00	9.00

TEST 94 2X LP180WMSE 120 FT SPACING 15 FT MTG H140 V PAGE 11

TEST GRID 3 COORDINATES OF CENTER X 210.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	X 245.00	X 250.00	X 255.00	X 260.00	
Y	55.00	1.7623	2.0231	2.2966	2.5133	2.6906	2.7222	2.6805	2.5085	2.2966	2.0231	55.00 Y
Z	9.00											9.00 Z
Y	50.00	1.9572	2.3293	2.7071	3.0352	3.2923	3.3534	3.2826	3.0314	2.7071	2.3293	50.00 Y
Z	9.00											9.00 Z
Y	45.00	2.1676	2.7066	3.2401	3.7458	4.1334	4.2474	4.1248	3.7434	3.2401	2.7066	45.00 Y
Z	9.00											9.00 Z
Y	40.00	2.3937	3.1409	3.9420	4.7408	5.3517	5.5646	5.3457	4.7400	3.9420	3.1055	40.00 Y
Z	9.00											9.00 Z
Y	35.00	2.4216	3.6329	4.8744	6.1532	7.1934	7.6016	7.1918	6.1532	4.8744	3.4918	35.00 Y
Z	9.00											9.00 Z
Y	30.00	2.8456	4.1843	6.1464	8.6949	10.2644	11.2543	11.0268	8.6951	6.0652	3.8414	30.00 Y
Z	9.00											9.00 Z
Y	25.00	3.2914	4.8372	8.5743	13.5148	16.6151	18.0479	18.5257	13.5149	8.1586	4.8373	25.
Z	9.00											[illegible] Z
Y	20.00	3.8812	6.5482	10.9380	21.6474	32.1252	31.9389	33.5167	21.4327	10.9379	6.5481	20.00 Y
Z	9.00											9.00 Z
Y	15.00	4.3276	8.2096	15.9811	34.2469	62.7413	62.4525	62.7412	32.4111	15.9809	8.2093	15.00 Y
Z	9.00											9.00 Z
Y	10.00	3.9307	8.5972	20.1685	34.6735	83.1895	123.9001	83.5857	34.6734	20.1683	8.5969	10.00 Y
Z	9.00											9.00 Z
Y	5.00	2.2763	5.4360	14.7822	33.9425	47.3419	68.1537	47.3418	33.9424	14.7821	5.0880	5.00 Y
Z	9.00											9.00 Z
Y	.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y
Z	9.00											9.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	9.00											9.00 Z

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00100 0000
00110      TEST 95     2X LP180WWNO    120 FT SPACING 15 FT MTG     H140 V
00120      LP180WWNO        1.00          0.85         1.00
00130      9999999999
00140      LP180WWNO        0.00          0.00        15.00       45.00       70.00
00150      LP180WWNO      120.00          0.00        15.00       45.00       70.00
00160      LP180WWNO      120.00          0.00        15.00      135.00       70.00
00170      LP180WWNO      240.00          0.00        15.00       45.00       70.00
00180      LP180WWNO      240.00          0.00        15.00      135.00       70.00
00190      LP180WWNO      360.00          0.00        15.00       45.00       70.00
00200      LP180WWNO      360.00          0.00        15.00      135.00       70.00
00210      LP180WWNO      480.00          0.00        15.00      135.00       70.00
00220      9999999999
00230         210.00       22.50          0.00         0.00        0.00
00240           5.00        5.00            20           13           V      270.00
00250         210.00       22.50          3.00         0.00        0.00
00260           5.00        5.00            20           13           V      270.00
00270         210.00       22.50          9.00         0.00        0.00
00280           5.00        5.00            20           13           V      270.00
00290      9999999999
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213

TEST 95 2X LP100WWNO 120 FT SPACING 15 FT MTG H140 V PAGE 4

TEST GRID 1 COORDINATES OF CENTER X 210.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	X 195.00	X 200.00	X 205.00	X 210.00	
Y 55.00 Z 0.00	3.0762	2.9017	2.7933	2.7502	2.7944	2.9039	3.0796	3.3132	3.6797	4.2126	55.00 Y 0.00 Z
Y 50.00 Z 0.00	3.3258	3.0955	2.9282	2.8739	2.9293	3.0975	3.3289	3.6450	4.0380	4.7800	50.00 Y 0.00 Z
Y 45.00 Z 0.00	3.5730	3.2237	3.0289	2.9637	3.0315	3.2287	3.5759	4.0066	4.5514	5.3285	45.00 Y 0.00 Z
Y 40.00 Z 0.00	3.7322	3.3019	3.0607	3.0021	3.0890	3.3211	3.7350	4.3860	5.1317	6.0307	40.00 Y 0.00 Z
Y 35.00 Z 0.00	3.8199	3.3058	3.0743	2.9877	3.0700	3.3491	3.8358	4.6057	5.7402	7.0056	35.00 Y 0.00 Z
Y 30.00 Z 0.00	3.8603	3.3674	3.0488	2.9056	2.9551	3.2111	3.7747	4.6915	6.0753	8.0747	30.00 Y 0.00 Z
Y 25.00 Z 0.00	4.0271	3.3436	2.8629	2.5833	2.6119	2.9127	3.5275	4.5581	6.1753	7.8984	25. 0.00 Z
Y 20.00 Z 0.00	3.8618	2.8109	2.2629	2.0634	2.1260	2.6499	3.0879	4.1562	5.6732	6.9531	20.00 Y 0.00 Z
Y 15.00 Z 0.00	2.7541	2.0027	1.6270	1.5279	1.6198	1.9218	2.4866	3.4471	4.4541	5.4945	15.00 Y 0.00 Z
Y 10.00 Z 0.00	1.7146	1.3287	1.1350	1.0760	1.1352	1.3291	1.7152	2.4229	2.9439	3.5549	10.00 Y 0.00 Z
Y 5.00 Z 0.00	.8320	.6594	.5733	.5470	.5733	.6596	.8322	1.1168	1.3982	1.7275	5.00 Y 0.00 Z
Y -.00 Z 0.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y 0.00 Z
Y -5.00 Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 0.00 Z

TEST GRID 1 COORDINATES OF CENTER X 210.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	X 245.00	X 250.00	X 255.00	X 260.00	
Y	55.00	5.1924	5.3727	5.3766	6.0909	6.7677	6.8729	6.7677	6.0909	5.3417	4.7751	55.00 Y
Z	0.00											0.00 Z
Y	50.00	5.7663	6.8025	6.8530	7.4825	8.3700	8.5712	8.3700	7.4825	6.5271	5.6796	50.00 Y
Z	0.00											0.00 Z
Y	45.00	6.7170	8.8310	8.9964	9.4050	10.6074	10.9572	10.6074	9.4050	8.0711	6.7970	45.00 Y
Z	0.00											0.00 Z
Y	40.00	7.6442	10.2948	12.1928	12.1322	13.3515	13.7721	13.3515	12.1322	10.0952	7.9607	40.00 Y
Z	0.00											0.00 Z
Y	35.00	8.5080	11.6055	14.4511	13.0223	14.3189	15.0512	14.3189	12.6478	11.1779	9.7213	35.00 Y
Z	0.00											0.00 Z
Y	30.00	9.4300	10.7313	13.3243	13.6888	14.5133	15.8278	14.5133	12.7597	10.8137	10.3156	30.00 Y
Z	0.00											0.00 Z
Y	25.00	9.4147	10.4039	11.6392	12.4241	12.8557	15.1743	12.8557	12.3974	10.9641	10.4039	25.00 Y
Z	0.00											0.00 Z
Y	20.00	8.3623	9.6050	10.0524	9.4805	9.9374	11.3148	9.9374	9.4805	10.0524	9.6050	20.00 Y
Z	0.00											0.00 Z
Y	15.00	6.6322	7.5628	7.8816	5.8310	6.6587	7.9678	7.0717	5.8310	7.8816	7.5628	15.00 Y
Z	0.00											0.00 Z
Y	10.00	4.2036	4.7666	3.8977	4.6665	4.7285	7.4282	4.7285	4.6665	3.8977	4.7666	10.00 Y
Z	0.00											0.00 Z
Y	5.00	1.9454	1.8525	1.7539	2.3598	3.3132	3.4018	3.3132	2.3598	1.7539	1.8525	5.00 Y
Z	0.00											0.00 Z
Y	.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST 95 2X LP180WWNO 120 FT SPACING 15 FT MTG H140 Y PAGE 7

TEST GRID 2 COORDINATES OF CENTER X 210.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	X 195.00	X 200.00	X 205.00	X 210.00	
Y	55.00	2.6970	2.5565	2.4763	2.4435	2.4774	2.5586	2.7001	2.8975	3.1343	3.4423	55.00 Y
Z	3.00											3.00 Z
Y	50.00	2.8928	2.7039	2.5766	2.5367	2.5725	2.7058	2.8956	3.1783	3.5343	4.0131	50.00 Y
Z	3.00											3.00 Z
Y	45.00	3.0982	2.8052	2.6514	2.6010	2.6522	2.8069	3.1008	3.4847	3.9770	4.6144	45.00 Y
Z	3.00											3.00 Z
Y	40.00	3.2476	2.8784	2.6711	2.6081	2.6719	2.8800	3.2500	3.8068	4.4796	5.3042	40.00 Y
Z	3.00											3.00 Z
Y	35.00	3.3373	2.8895	2.6274	2.5267	2.6170	2.8907	3.3394	4.0215	5.0119	6.1739	35.00 Y
Z	3.00											3.00 Z
Y	30.00	3.3432	2.8375	2.5241	2.3844	2.4717	2.7592	3.2957	4.1273	5.3543	7.1423	30.00 Y
Z	3.00											3.00 Z
Y	25.00	3.3512	2.7115	2.2971	2.1078	2.1916	2.5097	3.0858	4.0291	5.5025	7.7131	25.00 Y
Z	3.00											3.00 Z
Y	20.00	3.1334	2.2782	1.8418	1.6977	1.7792	2.1026	2.7022	3.6862	5.2594	7.8355	20.00 Y
Z	3.00											3.00 Z
Y	15.00	2.3031	1.4770	1.3633	1.2828	1.3605	1.6361	2.1471	3.0276	4.5308	7.1116	15.00 Y
Z	3.00											3.00 Z
Y	10.00	1.5016	1.1720	1.0074	.9569	1.0076	1.1724	1.5022	2.1143	3.2587	5.0076	10.00 Y
Z	3.00											3.00 Z
Y	5.00	.7726	.6142	.5362	.5118	.5362	.6143	.7729	1.0446	1.6022	2.3584	5.00 Y
Z	3.00											3.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y
Z	3.00											3.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0400	-5.00 Y
Z	3.00											3.00 Z

TEST 95 2X LP180WWNO 120 FT SPACING 15 FT MTG M140 V

TEST GRID 2 COORDINATES OF CENTER X 210.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	X 245.00	X 250.00	X 255.00	X 260.00	
Y / Z	55.00 / 3.00	4.1365	4.3746	4.4907	5.2416	5.9777	6.0769	5.9777	5.2416	4.4709	4.0460	55.00 Y / 3.00 Z
Y / Z	50.00 / 3.00	4.6446	5.5323	5.7164	6.4378	7.4089	7.4134	7.4089	6.4378	5.5144	4.8552	50.00 Y / 3.00 Z
Y / Z	45.00 / 3.00	5.5771	7.1972	7.5190	8.1088	9.4324	9.8047	9.4324	8.1088	6.9035	5.8781	45.00 Y / 3.00 Z
Y / Z	40.00 / 3.00	6.5707	8.5175	10.2588	10.5174	12.3889	13.0314	12.3889	10.5174	8.7658	7.0677	40.00 Y / 3.00 Z
Y / Z	35.00 / 3.00	7.5815	10.4047	14.5502	14.5794	16.8687	17.9591	16.8687	14.1132	11.2476	9.0226	35.00 Y / 3.00 Z
Y / Z	30.00 / 3.00	9.2130	12.1663	18.6819	20.2916	20.8714	22.2934	20.8714	18.0135	14.0734	11.6544	30.00 Y / 3.00 Z
Y / Z	25.00 / 3.00	11.0800	14.2950	17.9732	22.3309	21.6607	24.3467	21.6607	18.8472	15.8855	14.2950	25.00 Y / 3.00 Z
Y / Z	20.00 / 3.00	11.4695	14.4507	16.3635	18.4696	18.2778	23.5206	18.2778	16.9083	16.3635	14.4507	20.00 Y / 3.00 Z
Y / Z	15.00 / 3.00	9.5769	12.2925	14.3598	14.6588	13.5054	14.5895	14.2669	14.6588	14.3598	12.2925	15.00 Y / 3.00 Z
Y / Z	10.00 / 3.00	6.5814	8.4762	9.7812	8.2630	7.8801	11.8952	7.8801	8.2630	9.7812	9.2564	10.00 Y / 3.00 Z
Y / Z	5.00 / 3.00	3.1169	3.5178	3.6417	3.9364	5.7319	7.8067	5.7319	3.9364	3.6417	3.5178	5.00 Y / 3.00 Z
Y / Z	.00 / 3.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y / 3.00 Z
Y / Z	-5.00 / 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y / 3.00 Z

TEST 95 2X LP180WWNO 120 FT SPACING 15 FT MTG M140 Y

TEST GRID 3 COORDINATES OF CENTER X 210.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	X 195.00	X 200.00	X 205.00	X 210.00	
Y	55.00	1.9667	1.8800	1.8334	1.8087	1.8342	1.8817	1.9692	2.0926	2.2241	2.3600	55.00 Y
Z	9.00											9.00 Z
Y	50.00	2.1006	1.9018	1.8870	1.8560	1.8878	1.9630	2.1029	2.2745	2.4964	2.7068	50.00 Y
Z	9.00											9.00 Z
Y	45.00	2.2275	2.0311	1.9198	1.8827	1.9205	2.0325	2.2296	2.4666	2.7760	3.1335	45.00 Y
Z	9.00											9.00 Z
Y	40.00	2.2955	2.0517	1.9135	1.8681	1.9141	2.0530	2.2978	2.6586	3.0868	3.6188	40.00 Y
Z	9.00											9.00 Z
Y	35.00	2.3258	2.0318	1.8521	1.7944	1.8526	2.0329	2.3275	2.7700	3.3984	4.1491	35.00 Y
Z	9.00											9.00 Z
Y	30.00	2.2746	1.9205	1.7308	1.6697	1.7313	1.9214	2.2750	2.8189	3.6005	4.7120	30.00 Y
Z	9.00											9.00
Y	25.00	2.1103	1.7335	1.5270	1.4564	1.5274	1.7343	2.1116	2.7316	3.7004	5.1036	25.00 Y
Z	9.00											9.00 Z
Y	20.00	1.8266	1.4352	1.2343	1.1721	1.2347	1.4365	1.8276	2.4770	3.5161	5.2439	20.00 Y
Z	9.00											9.00 Z
Y	15.00	1.3971	1.0872	.9277	.8862	.9279	1.0877	1.3978	1.9563	2.9650	4.7700	15.00 Y
Z	9.00											9.00 Z
Y	10.00	.9826	.7886	.6871	.6555	.6872	.7889	.9830	1.3160	1.9531	3.3760	10.00 Y
Z	9.00											9.00 Z
Y	5.00	.5571	.4332	.3707	.3509	.3707	.4333	.5573	.7798	1.1792	1.9200	5.00 Y
Z	9.00											9.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y
Z	9.00											9.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	9.00											9.00 Z

TEST 95 2X LP180WWNO 120 FT SPACING 15 FT HTG H140 V

TEST GRID 3 COORDINATES OF CENTER X 210.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	X 245.00	X 250.00	X 255.00	X 260.00	
Y Z	55.00 9.00	2.6800	2.8926	3.0749	3.5935	4.1208	4.1885	4.1208	3.5935	3.0692	2.7922	55.00 Y 9.00 Z
Y Z	50.00 9.00	2.9231	3.4265	3.6930	4.2889	5.0539	5.2080	5.0539	4.2889	3.6440	3.2533	50.00 Y 9.00 Z
Y Z	45.00 9.00	3.4777	4.1479	4.5510	5.2088	6.3598	6.4768	6.3594	5.2088	4.4210	3.8553	45.00 Y 9.00 Z
Y Z	40.00 9.00	4.1912	4.7401	5.7828	6.4412	8.2455	8.8792	8.2455	6.4417	5.5007	4.7401	40.00 Y 9.00 Z
Y Z	35.00 9.00	5.0936	6.0294	7.6133	8.3929	11.0658	12.3489	11.0658	8.3142	7.0413	6.0294	35.00 Y 9.00 Z
Y Z	30.00 9.00	6.0937	7.8009	9.5235	12.3644	15.7909	18.2516	15.7909	11.7849	9.4462	7.8009	30.00 Y 9.00 Z
Y Z	25.00 9.00	7.1878	10.0439	14.0013	20.4538	24.2817	29.0546	24.2817	17.7453	13.4715	10.0439	25.00 Y 9.00 Z
Y Z	20.00 9.00	8.0560	12.8002	19.4376	32.6805	40.8813	50.9993	40.8813	26.8795	19.4376	12.8002	20.00 Y 9.00 Z
Y Z	15.00 9.00	8.1106	14.5900	27.2074	47.6124	80.2728	88.3213	71.1604	45.5649	27.2074	14.5900	15.00 Y 9.00 Z
Y Z	10.00 9.00	6.4820	13.4524	30.3814	57.0361	73.2128	93.4485	66.9674	57.0361	31.7464	16.3530	10.00 Y 9.00 Z
Y Z	5.00 9.00	3.5218	7.6886	19.4835	33.4817	32.6916	47.2399	32.6916	36.6044	22.2663	7.6886	5.00 Y 9.00 Z
Y Z	.00 9.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 9.00 Z
Y Z	-5.00 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 9.00 Z

00100 0000						
00110	TEST 96A	1X 400W HPS	80 FT SPACING	15 FT MTG		
00120	HS400WMWE	0.85	0.85	1.00		
00130	9999999999					
00140	HS400WMWE	0.00	0.00	15.00	90.00	60.00
00150	HS400WMWE	80.00	0.00	15.00	90.00	60.00
00160	HS400WMWE	160.00	0.00	15.00	90.00	60.00
00170	HS400WMWE	240.00	0.00	15.00	90.00	60.00
00180	HS400WMWE	320.00	0.00	15.00	90.00	60.00
00190	9999999999					
00200	140.00	22.50	0.00	0.00	0.00	
00210	5.00	5.00	10	15	V	270.00
00220	140.00	22.50	3.00	0.00	0.00	
00230	5.00	5.00	10	15	V	270.00
00240	140.00	22.50	9.00	0.00	0.00	
00250	5.00	5.00	10	15	V	270.00
00260	9999999999					

TEST 96A   1X 400W HPS   80 FT SPACING 15 FT MTG

TEST GRID I   COORDINATES OF CENTER X   140.00, Y   22.50, Z   0.00
ANGLES OF ORIENTATION HORZ   0.00, VERT   0.00

		X 120.00	X 125.00	X 130.00	X 135.00	X 140.00	X 145.00	X 150.00	X 155.00	X 160.00	X 165.00		
Y	60.00	2.9326	3.0113	3.1639	3.2698	3.3276	3.2766	3.1624	2.9850	2.9687	2.9850	60.00	Y
Z	0.00											0.00	Z
Y	55.00	3.0252	3.1736	3.4738	3.6687	3.8608	3.8981	3.8671	3.7564	3.7469	3.7564	55.00	Y
Z	0.00											0.00	Z
Y	50.00	3.2054	3.2928	3.6613	4.1165	4.4628	4.7098	4.8327	4.8478	4.8622	4.8478	50.00	Y
Z	0.00											0.00	Z
Y	45.00	3.4220	3.4231	3.6921	4.5179	5.2404	5.8461	6.1430	6.3300	6.4019	6.3291	45.00	Y
Z	0.00											0.00	Z
Y	40.00	3.5005	3.4749	3.6366	4.6947	6.1678	7.1377	7.7723	8.1736	8.3122	8.1728	40.00	Y
Z	0.00											0.00	Z
Y	35.00	2.9442	3.3104	3.9145	4.5800	6.7396	8.5253	9.9066	10.9025	11.2374	10.9023	35.00	Y
Z	0.00											0.00	Z
Y	30.00	2.2264	2.6842	3.8942	4.8677	6.5864	10.1483	12.7512	14.9388	15.5507	14.9388	30.00	Y
Z	0.00											0.00	Z
Y	25.00	1.8804	1.9730	2.6427	4.7451	6.5913	10.7294	15.5974	18.7887	19.8911	18.7887	25.00	Y
Z	0.00											0.00	Z
Y	20.00	.9650	1.2400	1.6691	2.8080	6.5390	9.6772	18.4410	22.4002	23.6742	22.4002	20.00	Y
Z	0.00											0.00	Z
Y	15.00	0.0000	.2106	.8097	1.9684	3.4079	9.0243	14.9339	23.3506	19.9225	23.3506	15.00	Y
Z	0.00											0.00	Z
Y	10.00	0.0000	0.0000	0.0000	0.0000	1.3974	3.8852	9.1189	13.5887	6.4435	13.5887	10.00	Y
Z	0.00											0.00	Z
Y	5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.8250	5.2354	2.6596	5.2354	5.00	Y
Z	0.00											0.00	Z
Y	-.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00	Y
Z	0.00											0.00	Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00	Y
Z	0.00											0.00	Z
Y	-10.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0060	0.0000	-10.00	Y
Z	0.00											0.00	Z

TEST 96A 1X 400W HPS 80 FT SPACING 15 FT MTG

TEST GRID 2 COORDINATES OF CENTER X 140.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 120.00	X 125.00	X 130.00	X 135.00	X 140.00	X 145.00	X 150.00	X 155.00	X 160.00	X 165.00	
Y 60.00 Z 3.00	2.7295	2.7655	2.8352	2.8978	2.9127	2.8106	2.5990	2.2856	2.2425	2.2856	60.00 Y 3.00 Z
Y 55.00 Z 3.00	2.8930	2.9380	3.1162	3.2517	3.3943	3.3609	3.2157	2.9115	2.8507	2.9115	55.00 Y 3.00 Z
Y 50.00 Z 3.00	3.0165	3.0792	3.3274	3.6696	3.9433	4.0893	4.0748	3.8201	3.7451	3.8201	50.00 Y 3.00 Z
Y 45.00 Z 3.00	3.1593	3.2000	3.4539	4.0894	4.6646	5.1257	5.2594	5.1288	5.0749	5.1280	45.00 Y 3.00 Z
Y 40.00 Z 3.00	3.2107	3.2521	3.5091	4.3724	5.6130	6.5412	6.9740	7.0784	7.0902	7.0777	40.00 Y 3.00 Z
Y 35.00 Z 3.00	2.8225	3.1326	3.7237	4.4867	6.5152	8.3234	9.4379	9.9679	10.1559	9.9678	35.00 Y 3.
Y 30.00 Z 3.00	2.2680	2.6470	3.7842	4.8818	6.6805	10.2772	12.6230	14.1612	14.7434	14.1812	30.00 Y 3.00 Z
Y 25.00 Z 3.00	1.9286	2.0312	2.7184	4.9338	6.8537	11.3121	16.7865	21.0885	22.6097	21.0885	25.00 Y 3.00 Z
Y 20.00 Z 3.00	1.0135	1.2875	1.7672	3.0145	7.1787	11.0036	21.2639	28.3518	31.0798	28.3518	20.00 Y 3.00 Z
Y 15.00 Z 3.00	0.0000	.2224	.8667	2.1666	3.9228	11.1141	20.3551	35.4712	37.3834	35.4712	15.00 Y 3.00 Z
Y 10.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	1.6594	5.0249	15.4798	29.2273	17.9737	29.2273	10.00 Y 3.00 Z
Y 5.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.8768	9.8512	5.3451	9.8512	5.00 Y 3.00 Z
Y -.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 3.00 Z
Y -5.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 3.00 Z
Y -10.00 Z 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-10.00 Y 3.00 Z

TEST 96A   1X 400W HPS   80 FT SPACING 15 FT MTG   PAGE 8

TEST GRID 3   COORDINATES OF CENTER X   140.00, Y   22.50, Z   9.00
               ANGLES OF ORIENTATION HORZ   0.00, VERT   0.00

		X 120.00	X 125.00	X 130.00	X 135.00	X 140.00	X 145.00	X 150.00	X 155.00	X 160.00	X 165.00		
Y	60.00	2.2334	2.2476	2.2756	2.3145	2.3010	2.1688	1.9516	1.6580	1.6106	1.6580	60.00	Y
Z	9.00											9.00	Z
Y	55.00	2.3912	2.3927	2.4632	2.5379	2.6245	2.5134	2.2904	1.9114	1.8210	1.9114	55.00	Y
Z	9.00											9.00	Z
Y	50.00	2.4954	2.5373	2.6498	2.8147	2.9708	2.9609	2.7601	2.2733	2.1117	2.2733	50.00	Y
Z	9.00											9.00	Z
Y	45.00	2.5942	2.6588	2.8378	3.1346	3.4268	3.6023	3.4171	2.7796	2.5053	2.7791	45.00	Y
Z	9.00											9.00	Z
Y	40.00	2.6383	2.7194	3.0117	3.4695	4.0362	4.5011	4.3770	3.5451	3.0320	3.5447	40.00	Y
Z	9.00											9.00	Z
Y	35.00	2.5000	2.6727	3.1213	3.8398	4.7944	5.6256	5.8355	4.8524	3.9265	4.8523	35.00	Y
Z	9.00											9.00	Z
Y	30.00	2.2384	2.4472	3.0978	4.0485	5.4581	7.2913	8.5528	7.9490	6.7317	7.9490	30.00	Y
Z	9.00											9.00	Z
Y	25.00	1.9370	2.0436	2.5478	3.9284	6.0310	9.3775	13.2224	14.2544	13.0435	14.2544	25.00	Y
Z	9.00											9.00	Z
Y	20.00	1.0231	1.3191	1.8467	3.1091	6.4214	10.9271	20.6054	26.5702	27.3376	26.5702	20.00	Y
Z	9.00											9.00	Z
Y	15.00	0.0000	.2236	.9225	2.3942	4.5360	12.7428	25.8121	50.2844	58.9738	50.2844	15.00	Y
Z	9.00											9.00	Z
Y	10.00	0.0000	0.0000	0.0000	0.0000	2.0376	7.0688	28.7148	85.0555	124.3192	85.0555	10.00	Y
Z	9.00											9.00	Z
Y	5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	6.6377	61.9192	71.8949	61.9192	5.00	Y
Z	9.00											9.00	Z
Y	-.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00	Y
Z	9.00											9.00	Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00	Y
Z	9.00											9.00	Z
Y	-10.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-10.00	Y
Z	9.00											9.00	Z

00100	0000					
00110	TEST 96B	1X 400W HPS	80 FT SPACING	15 FT MTG		
00120	HS400WMWE	0.85	0.85	1.00		
00130	9999999999					
00140	HS400WMWE	0.00	0.00	15.00	90.00	60.00
00150	HS400WMWE	80.00	0.00	15.00	90.00	60.00
00160	HS400WMWE	160.00	0.00	15.00	90.00	60.00
00170	HS400WMWE	240.00	0.00	15.00	90.00	60.00
00180	HS400WMWE	320.00	0.00	15.00	90.00	60.00
00190	9999999999					
00200	140.00	40.00	0.00	0.00	0.00	
00210	5.00	5.00	10	17	V	270.00
00220	140.00	40.00	3.00	0.00	0.00	
00230	5.00	5.00	10	17	V	270.00
00240	140.00	40.00	9.00	0.00	0.00	
00250	5.00	5.00	10	17	V	270.00
00260	9999999999					

TEST 968 1X 400W HPS 80 FT SPACING 15 FT MTG PAGE

TEST GRID 1 COORDINATES OF CENTER X 140.00, Y 40.00, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 120.00	X 125.00	X 130.00	X 135.00	X 140.00	X 145.00	X 150.00	X 155.00	X 160.00	X 165.00	
Y 82.50	Z 0.00	2.0885	2.0934	2.0582	1.9809	1.9048	1.7911	1.6386	1.5086	1.5146	1.5085	82.50 Y 0.00 Z
Y 77.50	Z 0.00	2.2930	2.2637	2.2475	2.1971	2.1127	2.0062	1.8442	1.6910	1.6890	1.6909	77.50 Y 0.00 Z
Y 72.50	Z 0.00	2.5103	2.4890	2.4728	2.4494	2.3669	2.2775	2.1082	1.9193	1.9204	1.9192	72.50 Y 0.00 Z
Y 67.50	Z 0.00	2.7050	2.7274	2.7264	2.7501	2.6918	2.6158	2.4385	2.2394	2.2337	2.2394	67.50 Y 0.00 Z
Y 62.50	Z 0.00	2.8650	2.9249	3.0110	3.0815	3.0983	3.0270	2.8871	2.6896	2.6682	2.6896	62.50 Y 0.00 Z
Y 57.50	Z 0.00	2.9871	3.0956	3.3300	3.4692	3.5835	3.5623	3.4887	3.3363	3.3241	3.3363	57.50 Y 0.00 Z
Y 52.50	Z 0.00	3.1128	3.2417	3.5840	3.8814	4.1351	4.2714	4.3185	4.2544	4.2529	4.2544	52.50 Y 0.00 Z
Y 47.50	Z 0.00	3.3000	3.3576	3.6966	4.3695	4.8192	5.2339	5.4322	5.5450	5.6005	5.5447	47.50 Y 0.00 Z
Y 42.50	Z 0.00	3.5467	3.4580	3.6387	4.6116	5.7200	6.5018	6.8980	7.1724	7.2585	7.1712	42.50 Y 0.00 Z
Y 37.50	Z 0.00	3.2642	3.4709	3.7598	4.6879	6.6115	7.8069	8.7588	9.3986	9.6157	9.3981	37.50 Y 0.00 Z
Y 32.50	Z 0.00	2.5336	3.0420	4.0215	4.7121	6.7300	9.3103	11.2460	12.7612	13.2657	12.7647	32.50 Y 0.00 Z
Y 27.50	Z 0.00	2.0688	2.2308	3.3462	4.9718	6.2776	10.8197	14.1735	16.7484	17.5650	16.7484	27.50 Y 0.00 Z
Y 22.50	Z 0.00	1.5776	1.6264	2.0310	3.8456	6.8374	10.2631	17.0557	21.0360	22.5464	21.0360	22.50 Y 0.00 Z
Y 17.50	Z 0.00	.4074	.6256	1.4347	2.3513	4.9547	9.8715	17.6521	23.3301	23.9608	23.3301	17.50 Y 0.00 Z
Y 12.50	Z 0.00	0.0000	0.0000	.1856	1.0620	2.7533	5.8138	12.3652	19.0457	11.5032	19.0457	12.50 Y 0.00 Z
Y 7.50	Z 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	1.7270	5.3418	8.3860	4.1162	8.3860	7.50 Y 0.00 Z

TEST 968 1X 400W HPS 80 FT SPACING 15 FT MTG PAGE

TEST GRID 2 COORDINATES OF CENTER X 140.00, Y 40.00, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 120.00	X 125.00	X 130.00	X 135.00	X 140.00	X 145.50	X 150.00	X 155.00	X 160.00	X 165.00	
Y	82.50	1.9316	1.9288	1.9123	1.8420	1.7696	1.6561	1.5075	1.3795	1.3815	1.3794	82.50 Y
Z	3.00											3.00 Z
Y	77.50	2.1147	2.0937	2.0783	2.0237	1.9296	1.8098	1.6319	1.4622	1.4573	1.4621	77.50 Y
Z	3.00											3.00 Z
Y	72.50	2.3054	2.2862	2.2644	2.2265	2.1220	2.0062	1.7905	1.5549	1.5509	1.5549	72.50 Y
Z	3.00											3.00 Z
Y	67.50	2.4810	2.4905	2.4739	2.4671	2.3700	2.2494	1.9869	1.6987	1.6848	1.6987	67.50 Y
Z	3.00											3.00 Z
Y	62.50	2.6458	2.6793	2.7068	2.7322	2.7071	2.5925	2.3630	2.0496	2.0119	2.0496	62.50 Y
Z	3.00											3.00 Z
Y	57.50	2.8126	2.8524	2.9817	3.0718	3.1429	3.0621	2.8829	2.5690	2.5184	2.5690	5[illegible]0 Y
Z	3.00											[illegible]0 Z
Y	52.50	2.9542	3.0155	3.2283	3.4483	3.6519	3.6943	3.6153	3.3230	3.2534	3.3230	52.50 Y
Z	3.00											3.00 Z
Y	47.50	3.0767	3.1478	3.4027	3.9121	4.2746	4.5641	4.6185	4.4111	4.3497	4.4109	47.50 Y
Z	3.00											3.00 Z
Y	42.50	3.2396	3.2348	3.4730	4.2336	5.1122	5.7913	6.0346	6.0063	5.9606	6.0053	42.50 Y
Z	3.00											3.00 Z
Y	37.50	3.0516	3.2489	3.6078	4.4678	6.1888	7.3734	8.0947	8.4255	8.5410	8.4251	37.50 Y
Z	3.00											3.00 Z
Y	32.50	2.5163	2.9287	3.8403	4.6660	6.6991	9.3071	10.9038	11.8222	12.1409	11.8254	32.50 Y
Z	3.00											3.00 Z
Y	27.50	2.1143	2.2816	3.3466	5.1005	6.4344	11.1159	14.6069	17.2261	18.1512	17.2261	27.50 Y
Z	3.00											3.00 Z
Y	22.50	1.6235	1.6815	2.1312	4.0495	7.2675	11.1996	19.2056	24.7653	26.6146	24.7653	22.50 Y
Z	3.00											3.00 Z
Y	17.50	.4166	.6555	1.5260	2.5537	5.5884	11.6028	22.0243	32.5829	35.9429	32.5829	17.50 Y
Z	3.00											3.00 Z
Y	12.50	0.0000	0.0000	.2019	1.1835	3.2355	7.3626	17.9857	37.2277	33.6812	37.2277	12.50 Y
Z	3.00											3.00 Z
Y	7.50	0.0000	0.0000	0.0000	0.0000	0.0000	2.3151	7.8961	18.5129	7.7498	18.5129	7.50 Y
Z	3.00											3.00 Z

TEST 968 1X 400W HPS 80 FT SPACING 15 FT MTG

TEST GRID 3 COORDINATES OF CENTER X 140.00, Y 40.00, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

	X 120.00	X 125.00	X 130.00	X 135.00	X 140.00	X 145.00	X 150.00	X 155.00	X 160.00	X 165.00	
Y 82.50 Z 9.00	1.5854	1.5875	1.5890	1.5337	1.4717	1.3782	1.2661	1.1696	1.1683	1.1696	82.50 Y 9.00 Z
Y 77.50 Z 9.00	1.7181	1.7146	1.7182	1.6792	1.5943	1.4911	1.3586	1.2329	1.2297	1.2328	77.50 Y 9.00 Z
Y 72.50 Z 9.00	1.8667	1.8645	1.8621	1.8359	1.7378	1.6331	1.4758	1.3076	1.3051	1.3076	72.50 Y 9.00 Z
Y 67.50 Z 9.00	2.0149	2.0211	2.0212	2.0191	1.9255	1.8098	1.6222	1.4136	1.4005	1.4136	67.50 Y 9.00 Z
Y 62.50 Z 9.00	2.1574	2.1760	2.1894	2.2087	2.1623	2.0328	1.8257	1.5586	1.5262	1.5586	62.50 Y 9.00 Z
Y 57.50 Z 9.00	2.3117	2.3194	2.3692	2.4225	2.4570	2.3252	2.1070	1.7741	1.7078	1.7741	57.50 Y 9.00 Z
Y 52.50 Z 9.00	2.4451	2.4666	2.5524	2.6666	2.7867	2.7184	2.5097	2.0753	1.9540	2.0753	52.50 Y 9.00 Z
Y 47.50 Z 9.00	2.5379	2.6122	2.7446	2.9790	3.1817	3.2520	3.0644	2.5019	2.3007	2.5017	47.50 Y 9.00 Z
Y 42.50 Z 9.00	2.6389	2.6976	2.9303	3.2932	3.7112	4.0267	3.8472	3.1226	2.7348	3.1220	42.50 Y 9.00 Z
Y 37.50 Z 9.00	2.5868	2.7201	3.0736	3.6561	4.4333	5.0219	5.0133	4.1044	3.4190	4.1041	37.50 Y 9.00 Z
Y 32.50 Z 9.00	2.3732	2.5817	3.1448	3.9876	5.1248	6.3637	6.9230	6.0548	4.9590	6.0568	32.50 Y 9.00 Z
Y 27.50 Z 9.00	2.1039	2.2647	2.8833	4.0493	5.7845	8.4128	10.6928	10.5981	9.2988	10.5981	27.50 Y 9.00 Z
Y 22.50 Z 9.00	1.6434	1.7058	2.1881	3.5699	6.3185	10.2403	16.4651	19.3275	18.6562	19.3275	22.50 Y 9.00 Z
Y 17.50 Z 9.00	.4121	.6752	1.6188	2.7738	5.6450	12.1209	24.4418	37.0850	40.2114	37.0850	17.50 Y 9.00 Z
Y 12.50 Z 9.00	0.0000	0.0000	.2094	1.3224	3.85[illegible]3	9.5674	27.2298	67.1460	90.4387	67.1460	12.50 Y 9.00 Z
Y 7.50 Z 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	3.4668	15.6911	81.4204	149.5335	81.4204	7.50 Y 9.00 Z

00100 0000						
00110	TEST 97	1X HS250WMWE	60 FT SPACING	15 FT MTG H129 V99		
00120	HS250WMWE	1.00	0.85	1.00		
00130	9999999999					
00140	HS250WMWE	0.00	0.00	15.00	90.00	60.0
00150	HS250WMWE	60.00	0.00	15.00	90.00	60.0
00160	HS250WMWE	120.00	0.00	15.00	90.00	60.0
00170	HS250WMWE	180.00	0.00	15.00	90.00	60.0
00180	HS250WMWE	240.00	0.00	15.00	90.00	60.0
00190	9999999999					
00200	105.00	22.50	0.00	0.00	0.00	
00210	5.00	5.00	10	13	V	270.0
00220	105.00	22.50	3.00	0.00	0.00	
00230	5.00	5.00	10	13	V	270.0
00240	105.00	22.50	9.00	0.00	0.00	
00250	5.00	5.00	10	13	V	270.0
00260	9999999999					

TEST GRID 1 COORDINATES OF CENTER X 105.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	X 130.00	
Y	55.00	3.0029	3.0723	3.0029	2.9852	2.9396	2.8685	2.7557	2.7251	2.7556	2.8684	55.00 Y
Z	0.00											0.00 Z
Y	50.00	3.3467	3.3018	3.3463	3.4352	3.4875	3.4467	3.3645	3.3263	3.3452	3.4454	50.00 Y
Z	0.00											0.00 Z
Y	45.00	3.6818	3.4172	3.6835	3.9896	4.1897	4.1912	4.1952	4.2018	4.1952	4.1921	45.00 Y
Z	0.00											0.00 Z
Y	40.00	3.9122	3.4817	3.9121	4.5520	4.8656	5.1040	5.3103	5.3859	5.3103	5.1039	40.00 Y
Z	0.00											0.00 Z
Y	35.00	3.8833	3.8725	3.8851	4.7179	5.5630	6.3577	6.9445	7.1625	6.9437	6.3564	35.00 Y
Z	0.00											0.00 Z
Y	30.00	3.8154	3.9641	3.8154	4.4840	6.4996	8.0027	9.2707	9.6035	9.2693	8.0053	30.00 Y
Z	0.00											0.00 Z
Y	25.00	3.5761	2.7841	3.5761	4.4905	6.8022	9.5522	11.3636	11.9946	11.3664	9.5542	25.00 Y
Z	0.00											0.00 Z
Y	20.00	2.3175	2.0030	2.3173	4.2177	5.9178	11.0644	13.4400	14.2047	13.4400	11.0644	20.00 Y
Z	0.00											0.00 Z
Y	15.00	1.2810	.9707	1.3042	2.0446	5.4142	8.9604	14.0105	11.9540	14.0105	8.9604	15.00 Y
Z	0.00											0.00 Z
Y	10.00	0.0000	0.0000	0.0000	.0384	2.3311	5.4715	8.1533	3.8662	8.1533	5.4715	10.00 Y
Z	0.00											0.00 Z
Y	5.00	0.0000	0.0000	0.0000	0.0000	0.0000	1.0950	3.1416	1.5956	3.1416	1.1044	5.00 Y
Z	0.00											0.00 Z
Y	.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST 97 1X MS250WMHE 60 FT SPACING 15 FT MIG M129 V99

TEST GRID 2 COORDINATES OF CENTER X 105.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	X 130.00	
Y Z	55.00 3.00	2.6906	2.7327	2.6906	2.6819	2.5765	2.4327	2.2102	2.1551	2.2101	2.4326	55.00 Y 3.00 Z
Y Z	50.00 3.00	3.0360	2.9992	3.0356	3.0750	3.0538	2.9410	2.7837	2.6378	2.7043	2.9416	50.00 Y 3.00 Z
Y Z	45.00 3.00	3.3673	3.1928	3.3670	3.5657	3.6909	3.6304	3.4667	3.4050	3.4667	3.6312	45.00 Y 3.00 Z
Y Z	40.00 3.00	3.6178	3.3344	3.6172	4.1312	4.4725	4.6222	4.6556	4.6545	4.6556	4.6221	40.00 Y 3.00 Z
Y Z	35.00 3.00	3.7121	3.6361	3.7137	4.5448	5.4477	6.0802	6.3871	6.5172	6.3864	6.0789	35.00 Y 3.00 Z
Y Z	30.00 3.00	3.7912	3.8226	3.7912	4.5522	6.5847	7.9355	8.8185	9.1205	8.8171	7.9331	30.00 Y 3.[illegible] Z
Y Z	25.00 3.00	3.7166	2.8703	3.7106	4.6630	7.1593	10.2681	12.7438	13.6245	12.7471	10.2706	25.[illegible] Y 3.00 Z
Y Z	20.00 3.00	2.4690	2.1207	2.4687	4.6096	6.7146	12.7587	17.0111	18.6477	17.0111	12.7587	20.00 Y 3.00 Z
Y Z	15.00 3.00	1.4335	1.3365	1.4270	2.3537	6.6684	12.2131	21.2828	22.4305	21.2828	12.2131	15.00 Y 3.00 Z
Y Z	10.00 3.00	0.0000	0.0000	0.0000	.9957	3.0149	9.2874	17.5370	10.7850	17.5370	9.2874	10.00 Y 3.00 Z
Y Z	5.00 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	1.7262	5.9114	3.2068	5.9114	1.7396	5.00 Y 3.00 Z
Y Z	.00 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00 Y 3.00 Z
Y Z	-5.00 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 3.00 Z

TEST 97 1X HS250WMWE 60 FT SPACING 15 FT MTG H129 V99 PAGE 8

TEST GRID 3 COORDINATES OF CENTER X 105.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 85.00	X 90.00	X 95.00	X 100.00	X 105.00	X 110.00	X 115.00	X 120.00	X 125.00	X 130.00		
Y	55.00	2.1122	2.1253	2.1122	2.1042	1.9674	1.7896	1.5337	1.4680	1.5336	1.7895	55.00	Y
Z	9.00											9.00	Z
Y	50.00	2.3672	2.3492	2.3620	2.3557	2.2631	2.0708	1.7257	1.6172	1.7261	2.0712	50.00	Y
Z	9.00											9.00	Z
Y	45.00	2.6088	2.5693	2.6086	2.6626	2.6660	2.4675	2.0296	1.8458	2.0296	2.4680	45.00	Y
Z	9.00											9.00	Z
Y	40.00	2.8439	2.7843	2.8438	3.0198	3.1754	3.0407	2.5214	2.2064	2.5214	3.0406	40.00	Y
Z	9.00											9.00	Z
Y	35.00	3.0708	2.9354	3.0718	3.4190	3.8152	3.9070	3.3085	2.7718	3.3081	3.9062	35.00	Y
Z	9.00											9.00	Z
Y	30.00	3.1822	3.0081	3.1822	3.8124	4.7875	5.4877	5.0729	4.3077	5.0721	5.4863	30.00	Y
Z	9.00											9.00	Z
Y	25.00	3.1224	2.0694	3.1224	4.1727	5.9981	8.1274	8.6415	7.8820	8.6438	8.1293	25.00	Y
Z	9.00											9.00	Z
Y	20.00	2.5463	2.2161	2.5459	4.1577	6.6666	12.3636	15.9423	16.4020	15.9423	12.3636	20.00	Y
Z	9.00											9.00	Z
Y	15.00	1.5707	1.0995	1.5612	2.7216	7.6452	15.4872	30.1711	35.3831	30.1711	15.4872	15.00	Y
Z	9.00											9.00	Z
Y	10.00	0.0000	0.0000	0.0000	1.2226	4.2414	17.2288	51.0346	74.5909	51.0346	17.2288	10.00	Y
Z	9.00											9.00	Z
Y	5.00	0.0000	0.0000	0.0000	0.0000	0.0000	3.9827	37.1496	43.1398	37.1496	3.7946	5.00	Y
Z	9.00											9.00	Z
Y	-.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	.00	Y
Z	9.00											9.00	Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00	Y
Z	9.00											9.00	Z

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00100 0000
00110      TEST 98     2X HS250WMWE    120 FT SPACING 15 FT MTG     H140 V9C
00120      HS250WMWE        1.00        0.85       1.00
00130      9999999999
00140      HS250WMWE        0.00        0.00      15.00      45.00      70.00
00150      HS250WMWE      120.00        0.00      15.00      45.00      70.00
00160      HS250WMWE      120.00        0.00      15.00     135.00      70.00
00170      HS250WMWE      240.00        0.00      15.00      45.00      70.00
00180      HS250WMWE      240.00        0.00      15.00     135.00      70.00
00190      HS250WMWE      360.00        0.00      15.00      45.00      70.00
00200      HS250WMWE      360.00        0.00      15.00     135.00      70.00
00210      HS250WMWE      480.00        0.00      15.00     135.00      70.00
00220      9999999999
00230          210.00      22.50        0.00       0.00       0.00
00240            5.00       5.00          20         13          V     270.00
00250          210.00      22.50        3.00       0.00       0.00
00260            5.00       5.00          20         13          V     270.00
00270          210.00      22.50        9.00       0.00       0.00
00280            5.00       5.00          20         13          V     270.00
00290      9999999999
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TEST 90 2X MS250MMWE 120 FT SPACING 15 FT MTG M140 V PAGE 4

TEST GRID 1 COORDINATES OF CENTER X 210.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	X 195.00	X 200.00	X 205.00	X 210.00	
Y	55.00	2.1630	2.0452	1.9743	1.9512	1.9755	2.0476	2.1667	2.3289	2.5229	2.7129	55.00 Y
Z	0.00											0.00 Z
Y	50.00	2.2920	2.1435	2.0529	2.0223	2.0540	2.1456	2.2952	2.5040	2.7649	3.0408	50.00 Y
Z	0.00											0.00 Z
Y	45.00	2.4107	2.2225	2.1124	2.0768	2.1133	2.2243	2.4134	2.6814	3.0249	3.4319	45.00 Y
Z	0.00											0.00 Z
Y	40.00	2.5053	2.2723	2.1388	2.0972	2.1396	2.2739	2.5077	2.8476	3.3003	3.7698	40.00 Y
Z	0.00											0.00 Z
Y	35.00	2.5549	2.2741	2.1119	2.0560	2.1127	2.2755	2.5570	2.9754	3.4626	4.0520	35.00 Y
Z	0.00											0.00 Z
Y	30.00	2.5208	2.1870	2.0045	1.9457	2.0051	2.1882	2.5226	2.9625	3.5328	4.2703	30.00 Y
Z	0.00											0.06 Z
Y	25.00	2.3319	1.9931	1.8073	1.7473	1.8078	1.9942	2.3334	2.8123	3.4592	4.3477	25.00 Y
Z	0.00											0.00 Z
Y	20.00	1.9865	1.6827	1.5269	1.4718	1.5273	1.6885	1.9877	2.4602	3.1615	4.1640	20.00 Y
Z	0.00											0.00 Z
Y	15.00	1.5313	1.2679	1.0956	1.0422	1.0959	1.2685	1.5322	1.9533	2.6242	3.6490	15.00 Y
Z	0.00											0.00 Z
Y	10.00	.9141	.7304	.6279	.5945	.6281	.7308	.9147	1.2327	1.7813	2.5882	10.00 Y
Z	0.00											0.00 Z
Y	5.00	.4090	.3433	.3070	.2952	.3071	.3435	.4093	.5197	.7012	.9921	5.00 Y
Z	0.00											0.00 Z
Y	-.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST 98 2X HS250WMWE 120 FT SPACING 15 FT MTG H150 V PAGE 5

TEST GRID 1 COORDINATES OF CENTER X 210.00, Y 22.50, Z 0.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	X 245.00	X 250.00	X 255.00	X 260.00	
Y	55.00	2.8898	3.2973	3.6538	3.4613	3.7084	4.2362	3.7084	3.4613	3.6538	3.2963	55.00 Y
Z	0.00											0.00 Z
Y	50.00	3.2882	3.6495	4.2513	4.1062	4.2638	4.9433	4.2638	4.1021	4.2508	3.6491	50.00 Y
Z	0.00											0.00 Z
Y	45.00	3.7742	4.0365	4.8094	4.9279	4.8787	5.8168	4.8787	4.8960	4.7899	4.0365	45.00 Y
Z	0.00											0.00 Z
Y	40.00	4.2550	4.6810	5.4253	6.0504	5.6941	6.9588	5.6921	5.9545	5.3960	4.6810	40.00 Y
Z	0.00											0.00 Z
Y	35.00	4.7272	5.4190	6.0269	7.5041	6.8668	8.4683	6.8516	7.3157	6.0269	5.4190	35.00 Y
Z	0.00											0.00 Z
Y	30.00	5.1860	6.2078	7.2623	8.8487	8.3730	10.1876	8.2945	8.6908	7.2623	6.2078	30.00 Y
Z	0.00											0.00 Z
Y	25.00	5.5181	6.7674	7.9186	9.7458	10.4775	12.0545	10.4315	9.7381	7.9186	6.7674	25.00 Y
Z	0.00											0.00 Z
Y	20.00	5.4224	6.7693	8.0612	9.8278	12.1548	12.3243	12.1548	9.8778	8.0612	6.7693	20.00 Y
Z	0.00											0.00 Z
Y	15.00	4.7582	6.0498	6.4754	6.5022	9.8229	11.3901	9.8413	6.5022	6.4754	6.0498	15.00 Y
Z	0.00											0.00 Z
Y	10.00	3.7114	4.9481	4.3398	2.5353	3.8955	9.5132	3.8955	2.5353	4.3398	4.9481	10.00 Y
Z	0.00											0.00 Z
Y	5.00	1.5239	2.2491	2.5873	1.9492	1.2703	2.8187	1.2703	1.9492	2.5873	2.2491	5.00 Y
Z	0.00											0.00 Z
Y	.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y
Z	0.00											0.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	0.00											0.00 Z

TEST 98 2X MS250WMWE 120 FT SPACING 15 FT MIG M140 V PAGE 7

TEST GRID 2 COORDINATES OF CENTER X 210.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 165.00	X 170.00	X 175.00	X 180.00	X 185.00	X 190.00	X 195.00	X 200.00	X 205.00	X 210.00	
Y Z	55.00 3.00	2.0025	1.8911	1.8286	1.8064	1.8298	1.8935	2.0061	2.1654	2.3613	2.5777	55.00 Y 3.00 Z
Y Z	50.00 3.00	2.1232	1.9882	1.9038	1.8748	1.9048	1.9903	2.1263	2.3260	2.5814	2.8705	50.00 Y 3.00 Z
Y Z	45.00 3.00	2.2404	2.0651	1.9652	1.9338	1.9660	2.0669	2.2431	2.4898	2.8197	3.2196	45.00 Y 3.00 Z
Y Z	40.00 3.00	2.3370	2.1252	2.0028	1.9625	2.0036	2.1268	2.3394	2.6521	3.0714	3.6015	40.00 Y 3.00 Z
Y Z	35.00 3.00	2.4003	2.1448	1.9977	1.9494	1.9984	2.1462	2.4024	2.7787	3.3127	4.0217	35.00 Y 3.00 Z
Y Z	30.00 3.00	2.3844	2.0869	1.9277	1.8759	1.9283	2.0881	2.3862	2.8426	3.5097	4.4436	30.00 Y 3.00 Z
Y Z	25.00 3.00	2.2541	1.9337	1.7613	1.7034	1.7617	1.9347	2.2556	2.7882	3.5830	4.6058	25.00 Y 3.00 Z
Y Z	20.00 3.00	1.9685	1.6561	1.4992	1.4452	1.4996	1.6569	1.9696	2.4948	3.3190	4.4761	20.00 Y 3.00 Z
Y Z	15.00 3.00	1.5383	1.2547	1.0815	1.0280	1.0817	1.2552	1.5392	2.0076	2.7405	3.9004	15.00 Y 3.00 Z
Y Z	10.00 3.00	.9274	.7278	.6223	.5887	.6225	.7282	.9280	1.2791	1.8744	2.8444	10.00 Y 3.00 Z
Y Z	5.00 3.00	.4193	.3451	.3063	.2942	.3064	.3453	.4195	.5447	.7471	1.1177	5.00 Y 3.00 Z
Y Z	-.00 3.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y 3.00 Z
Y Z	-5.00 3.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 3.00 Z

TEST 98 2X HS250WMWE 120 FT SPACING 15 FT MTG H140 Y PAGE 8

TEST GRID 2 COORDINATES OF CENTER X 210.00, Y 22.50, Z 3.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	X 245.00	X 250.00	X 255.00	X 260.00	
Y	55.00	2.7916	3.2245	3.6094	3.4370	3.7024	4.2400	3.7024	3.4370	3.6093	3.2218	55.00 Y
Z	3.00											3.00 Z
Y	50.00	3.1634	3.5677	4.2144	4.1093	4.2826	5.0111	4.2826	4.1093	4.2136	3.5643	50.00 Y
Z	3.00											3.00 Z
Y	45.00	3.6240	3.9851	4.8425	5.0260	5.0263	6.0426	5.0263	5.0260	4.8413	3.9851	45.00 Y
Z	3.00											3.00 Z
Y	40.00	4.2054	4.7383	5.5800	6.3101	5.9907	7.4089	5.9904	6.3042	5.5796	4.7383	40.00 Y
Z	3.00											3.00 Z
Y	35.00	4.8937	5.6847	6.2878	7.9332	7.3674	9.1923	7.3523	7.8615	6.2878	5.6847	35.00 Y
Z	3.00											3.00 Z
Y	30.00	5.4924	6.6698	7.7578	9.7389	9.4199	11.6893	9.3355	9.6106	7.7578	6.6698	30.00 Y
Z	3.00											3.00 Z
Y	25.00	5.9269	7.6035	9.4741	11.6998	12.7283	14.9667	12.4923	11.6066	9.4741	7.6035	25.0
Z	3.00											3.00 Z
Y	20.00	6.0931	8.3687	10.7784	13.5609	16.9689	18.6647	16.8346	13.5609	10.7784	8.3687	20.00 Y
Z	3.00											3.00 Z
Y	15.00	5.6937	8.0884	10.8616	12.6840	17.7354	18.6226	17.7576	12.6840	10.8616	8.0884	15.00 Y
Z	3.00											3.00 Z
Y	10.00	4.4526	6.7893	8.4603	6.4619	8.5375	16.6063	8.5375	6.4619	8.4603	6.7893	10.00 Y
Z	3.00											3.00 Z
Y	5.00	1.8718	3.2465	4.9424	4.2699	2.5065	7.7774	2.5065	4.2699	4.9424	3.2465	5.00 Y
Z	3.00											3.00 Z
Y	.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y
Z	3.00											3.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	3.00											3.00 Z

TEST GRID 3 COORDINATES OF CENTER X 210.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X	X	X	X	X	X	X	X	X	X	
		165.00	170.00	175.00	180.00	185.00	190.00	195.00	200.00	205.00	210.00	
Y	55.00	1.4966	1.3781	1.3124	1.2894	1.3135	1.3803	1.5000	1.6772	1.8920	2.1309	55.00 Y
Z	9.00											9.00 Z
Y	50.00	1.5817	1.4685	1.3920	1.3640	1.3930	1.4705	1.5847	1.7750	2.0343	2.3429	50.00 Y
Z	9.00											9.00 Z
Y	45.00	1.6820	1.5474	1.4814	1.4644	1.4823	1.5491	1.6846	1.8755	2.1838	2.5799	45.00 Y
Z	9.00											9.00 Z
Y	40.00	1.7670	1.6139	1.5651	1.5449	1.5658	1.6354	1.7693	2.0125	2.3426	2.8420	40.00 Y
Z	9.00											9.00 Z
Y	35.00	1.8711	1.7051	1.6120	1.5808	1.6127	1.7064	1.8731	2.1246	2.5505	3.1350	35.00 Y
Z	9.00											9.00 Z
Y	30.00	1.9202	1.7149	1.6058	1.5693	1.6064	1.7161	1.9219	2.2486	2.7394	3.5075	30.00 Y
Z	9.00											9.00 Z
Y	25.00	1.8985	1.6503	1.5101	1.4592	1.5106	1.6512	1.8999	2.2954	2.9054	3.7889	25.00 Y
Z	9.00											9.00 Z
Y	20.00	1.7469	1.4568	1.3101	1.2607	1.3105	1.4576	1.7480	2.2088	2.8905	3.9561	20.00 Y
Z	9.00											9.00 Z
Y	15.00	1.4125	1.1371	.9720	.9215	.9722	1.1376	1.4134	1.8728	2.5932	3.7749	15.00 Y
Z	9.00											9.00 Z
Y	10.00	.8736	.6793	.5799	.5488	.5801	.6797	.8741	1.2251	1.8459	2.9057	10.00 Y
Z	9.00											9.00 Z
Y	5.00	.4010	.3248	.2853	.2731	.2854	.3250	.4013	.5318	.7547	1.1848	5.00 Y
Z	9.00											9.00 Z
Y	0.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00 Y
Z	9.00											9.00 Z
Y	-5.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y
Z	9.00											9.00 Z

TEST 98 2X HS250WMWE 120 FT SPACING 15 FT MTG H140 V PAGE 11

TEST GRID 3 COORDINATES OF CENTER X 210.00, Y 22.50, Z 9.00
ANGLES OF ORIENTATION HORZ 0.00, VERT 0.00

		X 215.00	X 220.00	X 225.00	X 230.00	X 235.00	X 240.00	X 245.00	X 250.00	X 255.00	X 260.00	
Y Z	55.00 9.00	2.3884	2.8546	3.3083	3.2463	3.5063	3.9668	3.5063	3.2463	3.3080	2.8486	55.00 Y 9.00 Z
Y Z	50.00 9.00	2.6962	3.1643	3.8861	3.9057	4.1228	4.7911	4.1228	3.9057	3.8836	3.1551	50.00 Y 9.00 Z
Y Z	45.00 9.00	3.0482	3.5388	4.5061	4.8291	4.9289	5.9380	4.9289	4.8291	4.5003	3.5388	45.00 Y 9.00 Z
Y Z	40.00 9.00	3.4571	4.1931	5.2475	6.1604	5.9983	7.5004	5.9983	6.1604	5.2366	4.1931	40.00 Y 9.00 Z
Y Z	35.00 9.00	3.9628	4.9442	5.9407	7.9488	7.6196	9.6996	7.6196	7.9467	5.9407	4.9442	35.00 Y 9.00 Z
Y Z	30.00 9.00	4.5148	5.8887	7.4997	10.0759	10.2007	13.0823	10.2007	10.0679	7.4997	5.8837	30.00 Y 9.[illegible] Z
Y Z	25.00 9.00	5.1310	7.0809	9.6519	12.6878	14.9937	18.6520	14.9937	12.6741	9.6519	7.0809	25.[illegible] Y 9.00 Z
Y Z	20.00 9.00	5.6762	8.4566	12.7134	17.5497	23.9830	28.4279	23.9597	17.5497	12.7134	8.4566	20.00 Y 9.00 Z
Y Z	15.00 9.00	5.8033	9.5401	16.4620	25.5815	38.0228	45.8748	37.5097	25.5815	16.4020	9.5401	15.00 Y 9.00 Z
Y Z	10.00 9.00	4.8108	8.7818	17.0573	32.8213	53.6894	74.1357	53.6894	32.8213	17.0573	8.7818	10.00 Y 9.00 Z
Y Z	5.00 9.00	2.1723	4.5983	10.9896	26.8452	25.5750	66.1646	25.5750	26.8452	10.9896	4.5983	5.00 Y 9.00 Z
Y Z	.00 9.00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.00 Y 9.00 Z
Y Z	-5.00 9.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.00 Y 9.00 Z

APPENDIX D

ECONOMIC COMPARISONS

APPENDIX D

ECONOMIC COMPARISONS

INDEX

ECONOMIC COMPARISION

	PERIMETER LIGHTING SCHEME 1	PERIMETER LIGHTING SCHEME 2	PERIMETER LIGHTING SCHEME 3	PERIMETER LIGHTING SCHEME 4	PERIMETER LIGHTING SCHEME 5
I. INITIAL EQUIPMENT INVESTMENT					
1. QUANTITY OF LUMINAIRES	268	320	134	160	345
3. LUMINAIRE COST TOTAL	11256.00	17120.00	8710.00	10400.00	4485.00
4. QUANTITY OF POLES	134	160	67	160	115
9. POLE + FOUNDATION COST TOTAL	9380.00	11200.00	4690.00	11200.00	8050.00
14. ELECTRICAL DISTRIBUTION	26800.00	64000.00	40200.00	48000.00	34500.00
14A. STANDBY GENERATOR COST	22780.00	54400.00	34170.00	40800.00	29325.00
14C. UPS COST	0.00	0.00	0.00	0.00	0.00
16. TOTAL INIT EQUIP INCL LAMPS	73700.00	151200.00	89780.00	112800.00	80845.00
17. RELATIVE INIT EQUIP INVESTMENT	1.31	2.68	1.59	2.00	1.44
II. INITIAL LABOR ESTIMATES					
20. NET LABOR, POLES + LUMINAIRES	36850.00	46400.00	20435.00	36800.00	38525.00
21. LABOR ELECTRICAL DISTRIBUTION	20100.00	48000.00	30150.00	36000.00	25875.00
22. TOTAL INITIAL LABOR	59630.00	100800.00	54605.00	77600.00	67850.00
23. TOTAL INITIAL INVESTMENT	133330.00	252000.00	298785.00	344800.00	303095.00
24. RELATIVE INITIAL INVESTMENT	1.00	1.89	2.24	2.59	2.27
IV. ANNUAL COSTS					
31. TOTAL SYSTEM KW	134.	320.	201.	240.	173.
33. TOTAL ENERGY KWH/YEAR	536000.	1280000.	804000.	960000.	690000.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00	0.00	0.00
37. ANNUAL KWH COST	10720.00				
37D. DIESEL FUEL COST	214.40	512.00	321.60	384.00	276.00
40. REPLACEMENT LAMP COST	10452.00	13440.00	6038.00	7200.00	13455.00
V. ANNUAL MAINTENANCE, LABOR + MATERIALS					
44. RELAMPING COST - LABOR	2680.00	3200.00	1340.00	1600.00	3450.00
47. CLEANING COST - LABOR	0.00	0.00	0.00	0.00	0.00
50. PAINTING COST - LABOR	0.00	0.00	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	702.16	1467.20	877.70	1104.00	763.60
52. TOTAL ANNUAL MAINTENANCE COST	3382.16	4667.20	2217.70	2704.00	4213.60
53. ANNUAL OPERATING COST	24768.56	44219.20	26649.30	29488.00	31744.60
VI. ANNUAL OWNERSHIP + OPERATING COST					
55. FIXED OWNERSHIP COST	18438.13	35147.84	20217.25	26696.00	20477.82
56. ANNUAL OWNERSHIP + OPRTING COST	43206.69	79367.04	46866.55	56184.00	52222.42
VII. RELATIVE COSTS OF LIGHT					
59. RELATIVE COST EXCLUDING FIXED	6.64	11.85	6.61	7.90	8.51
60. RELATIVE TOTAL COST	2.98	5.33	3.01	3.77	3.51

SHT. 1

ECONOMIC COMPARISION

	PERIMETER LIGHTING SCHEME 6	PERIMETER LIGHTING SCHEME 7	PERIMETER LIGHTING SCHEME 8	PERIMETER LIGHTING SCHEME 9	PERIMETER LIGHTING SCHEME 10
I. INITIAL EQUIPMENT INVESTMENT					
1. QUANTITY OF LUMINAIRES	200	134	134	100	160
3. LUMINAIRE COST TOTAL	78000.00	32160.00	32160.00	25000.00	43680.00
6. QUANTITY OF POLES	200	134	67	100	80
9. POLE + FOUNDATION COST TOTAL	88000.00	9380.00	4690.00	7000.00	5600.00
14. ELECTRICAL DISTRIBUTION	14500.00	9715.00	9715.00	11500.00	5600.00
14A. STANDBY GENERATOR COST	12325.00	8257.75	8257.75	9775.00	4760.00
14C. UPS COST	43500.00	29145.00	29145.00	34500.00	16800.00
16. TOTAL INIT EQUIP INCL LAMPS	243925.00	92677.75	89059.75	91675.00	79320.00
17. RELATIVE INIT EQUIP INVESTMENT	4.33	1.65	1.58	1.63	1.41
II. INITIAL LABOR ESTIMATES					
20. NET LABOR, POLES + LUMINAIRES	44400.00	28810.00	18425.00	23000.00	17200.00
21. LABOR ELECTRICAL DISTRIBUTION	10875.00	7286.25	7286.25	8625.00	4200.00
22. TOTAL INITIAL LABOR	62525.00	40953.75	30568.75	37375.00	24200.00
23. TOTAL INITIAL INVESTMENT	460850.00	288031.50	274028.50	283450.00	257920.00
24. RELATIVE INITIAL INVESTMENT	3.46	2.16	2.06	2.13	1.93
IV. ANNUAL COSTS					
31. TOTAL SYSTEM KW	73.	49.	49.	58.	28.
33. TOTAL ENERGY KWH/YEAR	290000.	194300.	194300.	230000.	112000.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00	0.00	0.00
37. ANNUAL KWH COST	5800.00				
37D. DIESEL FUEL COST	116.00	77.72	77.72	92.00	44.80
40. REPLACEMENT LAMP COST	3840.00	2031.16	2572.80	1440.00	921.60
V. ANNUAL MAINTENANCE, LABOR + MATERIALS					
44. RELAMPING COST - LABOR	336.84	225.68	225.68	123.08	170.67
47. CLEANING COST - LABOR	231.58	155.16	155.16	138.46	234.67
50. PAINTING COST - LABOR	0.00	0.00	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	2363.25	886.58	839.68	877.75	764.40
52. TOTAL ANNUAL MAINTENANCE COST	2931.67	1267.42	1220.52	1139.29	1169.73
53. ANNUAL OPERATING COST	12687.67	7262.30	7757.04	7271.29	4376.13
VI. ANNUAL OWNERSHIP + OPERATING COST					
55. FIXED OWNERSHIP COST	42436.70	18404.83	16264.18	17771.30	14290.88
56. ANNUAL OWNERSHIP + OP-ING COST	55124.37	25667.13	24021.22	25042.59	18667.01
VII. RELATIVE COSTS OF LIGHT					
59. RELATIVE COST EXCLUDING FIXED	3.40	1.95	2.08	1.95	1.17
60. RELATIVE TOTAL COST	3.70	1.72	1.61	1.68	1.25

ECONOMIC COMPARISION

	PERIMETER LIGHTING SCHEME 11	PERIMETER LIGHTING SCHEME 12	PERIMETER LIGHTING SCHEME 13	PERIMETER LIGHTING SCHEME 14	PERIMETER LIGHTING SCHEME 15
I. INITIAL EQUIPMENT INVESTMENT					
1. QUANTITY OF LUMINAIRES	160	134	134	134	201
3. LUMINAIRE COST TOTAL	49280.00	48240.00	45426.00	48240.00	50250.00
4. QUANTITY OF POLES	80	134	67	67	67
9. POLE + FOUNDATION COST TOTAL	5600.00	9380.00	4690.00	4690.00	8710.00
14. ELECTRICAL DISTRIBUTION	5600.00	8040.00	8040.00	9040.00	12060.00
14A. STANDBY GENERATOR COST	4760.00	6834.00	6834.00	6834.00	10251.00
14C. UPS COST	16800.00	24120.00	24120.00	24120.00	36180.00
16. TOTAL INIT EQUIP INCL LAMPS	84920.00	101036.00	93532.00	96346.00	124084.00
17. RELATIVE INIT EQUIP INVESTMENT	1.51	1.79	1.66	1.71	2.20
II. INITIAL LABOR ESTIMATES					
20. NET LABOR, POLES + LUMINAIRES	17200.00	30820.00	20435.00	20435.00	25929.00
21. LABOR ELECTRICAL DISTRIBUTION	4200.00	6030.00	6030.00	6030.00	9045.00
22. TOTAL INITIAL LABOR	24200.00	40870.00	30485.00	30485.00	41004.00
23. TOTAL INITIAL INVESTMENT	263520.00	296306.00	278417.00	281231.00	319488
24. RELATIVE INITIAL INVESTMENT	1.98	2.22	2.09	2.11	2
IV. ANNUAL COSTS					
31. TOTAL SYSTEM KW	28.	40.	40.	40.	60.
33. TOTAL ENERGY KWH/YEAR	112000.	160800.	160800.	160800.	241200.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00	0.00	0.00
37. ANNUAL KWH COST	2240.00				
37D. DIESEL FUEL COST	44.80	64.32	64.32	64.32	96.48
40. REPLACEMENT LAMP COST	921.60	1415.04	1202.78	1415.04	2122.56
V. ANNUAL MAINTENANCE, LABOR + MATERIALS					
44. RELAMPING COST - LABOR	170.67	142.93	110.77	142.93	214.40
47. CLEANING COST - LABOR	234.67	196.53	196.53	196.53	294.80
50. PAINTING COST - LABOR	0.00	0.00	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	820.40	966.14	891.10	919.24	1174.51
52. TOTAL ANNUAL MAINTENANCE COST	1225.73	1305.61	1198.41	1258.71	1683.71
53. ANNUAL OPERATING COST	4432.13	6080.97	5681.51	5954.07	8726.75
VI. ANNUAL OWNERSHIP + OPERATING COST					
55. FIXED OWNERSHIP COST	15086.08	19522.73	16982.49	17382.08	22500.61
56. ANNUAL OWNERSHIP + OPRING COST	19518.21	25523.69	22664.00	23336.14	31227.36
VII. RELATIVE COSTS OF LIGHT					
59. RELATIVE COST EXCLUDING FIXED	1.19	1.61	1.52	1.60	2.34
60. RELATIVE TOTAL COST	1.31	1.71	1.52	1.57	2.10

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT [redacted]

ECONOMIC COMPARISION

	PERIMETER LIGHTING SCHEME 16	PERIMETER LIGHTING SCHEME 17	PERIMETER LIGHTING SCHEME 18	PERIMETER LIGHTING SCHEME 19	PERIMETER LIGHTING SCHEME 20
I. INITIAL EQUIPMENT INVESTMENT					
1. QUANTITY OF LUMINAIRES	115	160	134	268	268
3. LUMINAIRE COST TOTAL	28750.00	40060.00	32160.00	40870.00	40870.00
4. QUANTITY OF POLES	115	80	67	67	67
9. POLE + FOUNDATION COST TOTAL	8050.00	5600.00	4690.00	4690.00	4690.00
14. ELECTRICAL DISTRIBUTION	6900.00	9600.00	7772.00	47972.00	34572.00
14A. STANDBY GENERATOR COST	5865.00	8160.00	6606.20	40776.20	29386.20
14C. UPS COST	20100.00	28800.00	0.00	0.00	0.00
16. TOTAL INIT EQUIP INCL LAMPS	74080.00	97440.00	56320.20	141410.20	116496.20
17. RELATIVE INIT EQUIP INVESTMENT	1.31	1.73	1.00	2.51	2.07
II. INITIAL LABOR ESTIMATES					
20. NET LABOR, POLES + LUMINAIRES	26450.00	24400.00	18425.00	28475.00	28475.00
21. LABOR ELECTRICAL DISTRIBUTION	5175.00	7200.00	5829.00	35979.00	25929.00
22. TOTAL INITIAL LABOR	35075.00	36400.00	25031.20	69251.20	57561.20
23. TOTAL INITIAL INVESTMENT	263535.00	288240.00	235751.40	210661.40	174347.40
24. RELATIVE INITIAL INVESTMENT	1.98	2.16	1.77	1.58	1.31
IV. ANNUAL COSTS					
31. TOTAL SYSTEM KW	35.	48.	39.	240.	173.
33. TOTAL ENERGY KWH/YEAR	138000.	192000.	155440.	159460.	158120.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00	0.00	0.00
37. ANNUAL KWH COST	2760.00				
37D. DIESEL FUEL COST	55.20	76.80	62.18	383.78	276.58
40. REPLACEMENT LAMP COST	1214.40	1689.60	2572.80	2602.95	2600.94
V. ANNUAL MAINTENANCE, LABOR + MATERIALS					
44. RELAMPING COST - LABOR	122.67	170.67	225.68	232.38	232.38
47. CLEANING COST - LABOR	168.67	234.67	155.16	419.81	419.81
50. PAINTING COST - LABOR	0.00	0.00	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	702.65	921.60	512.28	1343.08	1095.18
52. TOTAL ANNUAL MAINTENANCE COST	993.98	1326.93	893.12	1995.27	1747.37
53. ANNUAL OPERATING COST	5023.58	6933.33	6636.90	8171.20	7733.69
VI. ANNUAL OWNERSHIP + OPERATING COST					
55. FIXED OWNERSHIP COST	14958.28	18255.52	10828.83	28905.43	23767.87
56. ANNUAL OWNERSHIP + OPRING COST	19981.86	25188.85	17465.73	37076.63	31501.56
VII. RELATIVE COSTS OF LIGHT					
59. RELATIVE COST EXCLUDING FIXED	1.35	1.86	1.78	2.19	2.07
60. RELATIVE TOTAL COST	1.34	1.69	1.17	2.49	2.12

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT [redacted]

ECONOMIC COMPARISION

	PERIMETER LIGHTING SCHEME 21	PERIMETER LIGHTING SCHEME 22	PERIMETER LIGHTING SCHEME 23	PERIMETER LIGHTING SCHEME 24	PERIMETER LIGHTING SCHEME 25
I. INITIAL EQUIPMENT INVESTMENT					
1. QUANTITY OF LUMINAIRES	335	160	320	320	400
3. LUMINAIRE COST TOTAL	40602.00	43680.00	54080.00	54080.00	53760.00
4. QUANTITY OF POLES	67	80	80	80	80
9. POLE + FOUNDATION COST TOTAL	4690.00	5600.00	5600.00	5600.00	5600.00
14. ELECTRICAL DISTRIBUTION	27872.00	6480.00	52480.00	36490.00	28480.00
14A. STANDBY GENERATOR COST	23691.20	3808.00	44608.00	31008.00	24208.00
14C. UPS COST	0.00	0.00	0.00	0.00	0.00
16. TOTAL INIT EQUIP INCL LAMPS	104560.20	60448.00	162048.00	132288.00	119048.00
17. RELATIVE INIT EQUIP INVESTMENT	1.86	1.07	2.88	2.35	2.10
II. INITIAL LABOR ESTIMATES					
20. NET LABOR, POLES + LUMINAIRES	30485.00	17200.00	29200.00	29200.00	31600.00
21. LABOR ELECTRICAL DISTRIBUTION	20904.00	3360.00	39360.00	27360.00	21360.00
22. TOTAL INITIAL LABOR	54176.20	21008.00	73808.00	60208.00	55808.00
23. TOTAL INITIAL INVESTMENT	158736.40	158841.00	235856.00	192496.00	173856
24. RELATIVE INITIAL INVESTMENT	1.19	1.19	1.77	1.44	1
IV. ANNUAL COSTS					
31. TOTAL SYSTEM KW	139.	22.	262.	182.	142.
33. TOTAL ENERGY KWH/YEAR	157450.	89600.	94400.	92800.	92000.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00	0.00	0.00
37. ANNUAL KWH COST	3149.00				
370. DIESEL FUEL COST	222.98	35.84	419.84	291.84	227.84
40. REPLACEMENT LAMP COST	2612.00	921.60	957.60	955.20	968.40
V. ANNUAL MAINTENANCE, LABOR + MATERIALS					
44. RELAMPING COST - LABOR	235.73	170.67	178.67	178.67	182.67
47. CLEANING COST - LABOR	552.13	234.67	550.67	550.67	708.67
50. PAINTING COST - LABOR	0.00	0.00	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	968.55	575.68	1567.68	1271.68	1120.68
52. TOTAL ANNUAL MAINTENANCE COST	1756.42	981.01	2297.01	2001.01	2011.81
53. ANNUAL OPERATING COST	7740.39	3730.45	5562.45	5104.05	5048.05
VI. ANNUAL OWNERSHIP + OPERATING COST					
55. FIXED OWNERSHIP COST	21446.46	11157.79	32741.79	26607.39	23835.55
56. ANNUAL OWNERSHIP + OP'ING COST	29186.85	14888.25	38304.25	31711.45	28883.61
VII. RELATIVE COSTS OF LIGHT					
59. RELATIVE COST EXCLUDING FIXED	2.07	1.00	1.49	1.37	1.35
60. RELATIVE TOTAL COST	1.96	1.00	2.57	2.13	1.94

5

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

	PERIMETER LIGHTING SCHEME 26	PERIMETER LIGHTING SCHEME 27	PERIMETER LIGHTING SCHEME 28
I. INITIAL EQUIPMENT INVESTMENT			
1. QUANTITY OF LUMINAIRES	160	100	134
3. LUMINAIRE COST TOTAL	10400.00	25000.00	48240.00
4. QUANTITY OF POLES	160	100	134
9. POLE + FOUNDATION COST TOTAL	11200.00	7000.00	9380.00
14. ELECTRICAL DISTRIBUTION	48000.00	11500.00	8040.00
14A. STANDBY GENERATOR COST	40800.00	9775.00	6834.00
14C. UPS COST	0.00	34500.00	24120.00
16. TOTAL INIT EQUIP INCL LAMPS	112800.00	91675.00	101036.00
17. RELATIVE INIT EQUIP INVESTMENT	1.23	1.00	1.10
II. INITIAL LABOR ESTIMATES			
20. NET LABOR, POLES + LUMINAIRES	36800.00	23000.00	30820.00
21. LABOR ELECTRICAL DISTRIBUTION	36000.00	8625.00	6030.00
22. TOTAL INITIAL LABOR	77600.00	37375.00	40870.00
23. TOTAL INITIAL INVESTMENT	190400.00	129050.00	141906.00
24. RELATIVE INITIAL INVESTMENT	1.48	1.00	1.10
IV. ANNUAL COSTS			
31. TOTAL SYSTEM KW	240.	58.	40.
33. TOTAL ENERGY KWH/YEAR	960000.	230000.	160800.
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00
37. ANNUAL KWH COST	19200.00		
37D. DIESEL FUEL COST	384.00	92.00	64.32
40. REPLACEMENT LAMP COST	7200.00	1440.00	1415.04
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
44. RELAMPING COST - LABOR	1600.00	123.08	142.93
47. CLEANING COST - LABOR	0.00	138.46	196.53
50. PAINTING COST - LABOR	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	1104.00	877.75	966.14
52. TOTAL ANNUAL MAINTENANCE COST	2704.00	1139.29	1305.61
53. ANNUAL OPERATING COST	29488.00	7271.29	6000.97
VI. ANNUAL OWNERSHIP + OPERATING COST			
55. FIXED OWNERSHIP COST	26696.00	17771.30	19522.73
56. ANNUAL OWNERSHIP + OP'ING COST	56184.00	25042.59	25523.69
VII. RELATIVE COSTS OF LIGHT			
59. RELATIVE COST EXCLUDING FIXED	4.91	1.21	1.00
60. RELATIVE TOTAL COST	2.24	1.00	1.02

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER	TEST 50 2X500W QUARTZ H100 V93
LIGHTING	60 DEGREE AIMING
SCHEME 1	HORIZONTAL POSITION 60 135 DEGREES

	TOTAL FOR SYSTEM	2X500W QTZ Q500WMGE 60 FT SP 15 FT MTG
I. INITIAL EQUIPMENT INVESTMENT		
1. QUANTITY OF LUMINAIRES	268	268
2. LUMINAIRE COST EACH		42.00
3. LUMINAIRE COST TOTAL	11256.00	11256.00
4. QUANTITY OF POLES	134	134
5. MOUNTING HEIGHT		15.00
6. POLE + BRACKET COST EACH		70.00
7. POLE COST TOTAL		9380.00
8. FOUNDATION COST EACH		0.00
9. POLE + FOUNDATION COST TOTAL	9380.00	9380.00
10. QTY LAMPS PER LUMINAIRE		1
11. QUANTITY LAMPS		268
12. LAMP COST EACH		13.00
13. LAMP COST TOTAL	3484.00	3484.00
14. ELECTRICAL DISTRIBUTION	26800.00	26800.00
14A. STANDBY GENERATOR COST	22780.00	22780.00
14C. UPS COST	0.00	0.00
15. TOTAL INIT EQUIP LESS LAMPS		70216.00
16. TOTAL INIT EQUIP INCL LAMPS	73700.00	73700.00
II. INITIAL LABOR ESTIMATES		
18. POLE ERECTION + PAINTING		155.00
19. LUMINAIRE LABOR		60.00
20. NET LABOR, POLES + LUMINAIRES	36850.00	36850.00
21. LABOR ELECTRICAL DISTRIBUTION	20100.00	20100.00
21A. LABOR STANDBY GENERATOR	2680.00	2680.00
21B. LABOR UPS	0.00	0.00
22. TOTAL INITIAL LABOR	59630.00	59630.00
23. TOTAL INITIAL INVESTMENT	133330.00	133330.00
III. ILLUMINATION CALCULATIONS		
25. SPACING OR AREA		60.00
26. UTILIZATION FACTOR		0.00
27. MAINTENANCE FACTOR		.81
28. DESIGN FOOTCANDLES		2.00
29. INIT COST PER LINEAL FT [redacted]	16.58	16.58

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER	TEST 50 2X500W QUARTZ H100 V93	
LIGHTING	60 DEGREE AIMING	
SCHEME 1	HORIZONTAL POSITION 60 _ 135 DEGREES	

	TOTAL FOR SYSTEM	2X500W QTZ Q500WMGE 60 FT SP 15 FT MTG
IV. ANNUAL COSTS		
30. KW PER LUMINAIRE		.50
30A. KW UPS POWER LOSS		0.00
31. TOTAL SYSTEM KW	134.	134.
32. ANNUAL OPERATION (HOURS)		4000.
33. TOTAL ENERGY KWH/YEAR	536000.	536000.
34. ENERGY COST PER KWH		.0200
35. DEMAND CHARGE/KW/MONTH		0.0000
36. DEMAND CHARGE PER YEAR	0.00	0.00
37. ANNUAL KWH COST	10720.00	10720.00
37D. DIESEL FUEL COST	214.40	214.40
38. GROUP RELAMPING PERIOD (HOURS)		1600.
38A. RATED LAMP LIFE (HOURS)		2000.
38B. PORTION OF LAMPS SPOT REPLACED		.20
39. QUANTITY OF REPLACEMENT LAMPS		804.
40. REPLACEMENT LAMP COST	10452.00	10452.00
V. ANNUAL MAINTENANCE, LABOR + MATERIALS		
43. GROUP RELAMPINGS/YEAR/LUMINAIRE		2.50
43A. SPOT RELAMPINGS/YEAR/LUMINAIRE		.5000
44. RELAMPING COST - LABOR	2680.00	2680.00
46. CLEANINGS/YEAR/LUMINAIRE		0.00
47. CLEANING COST - LABOR	0.00	0.00
48. PAINTING TIME PER POLE		0.00
50. PAINTING COST - LABOR	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	702.16	702.16
52. TOTAL ANNUAL MAINTENANCE COST	3382.16	3382.16
53. ANNUAL OPERATING COST	24768.56	24768.56
54. ANNUAL OP"NG COST PER FT ~~OR ACRE~~	3.08	3.08
VI. ANNUAL OWNERSHIP + OPERATING COST		
55. FIXED OWNERSHIP COST	18438.13	18438.13
56. ANNUAL OWNERSHIP + OP"ING COST	43206.69	43206.69
58. TOTAL PER LINEAL FOOT ~~OR ACRE~~	5.37	5.37

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER TEST 6 1X500 _ 1X1500W QUARTZ
LIGHTING 50 DEGREE AIMING 50 FT SPACING
SCHEME 2 HORIZONTAL POSITION 90 _ 135 DEGREES

		TOTAL FOR SYSTEM	500W 90 DEGREE 15 FT MTG	1500W 135 DEGREE 15 FT MTG
I. INITIAL EQUIPMENT INVESTMENT				
1.	QUANTITY OF LUMINAIRES	320	160	160
2.	LUMINAIRE COST EACH		42.00	65.00
3.	LUMINAIRE COST TOTAL	17120.00	6720.00	10400.00
4.	QUANTITY OF POLES	160	160	0
5.	MOUNTING HEIGHT		15.00	15.00
6.	POLE + BRACKET COST EACH		70.00	0.00
7.	POLE COST TOTAL		11200.00	0.00
8.	FOUNDATION COST EACH		0.00	0.00
9.	POLE + FOUNDATION COST TOTAL	11200.00	11200.00	0.00
10.	QTY LAMPS PER LUMINAIRE		1	1
11.	QUANTITY LAMPS		160	160
12.	LAMP COST EACH		13.00	15.00
13.	LAMP COST TOTAL	4480.00	2080.00	2400.00
14.	ELECTRICAL DISTRIBUTION	64000.00	16000.00	48000.00
14A.	STANDBY GENERATOR COST	54400.00	13600.00	40800.00
14C.	UPS COST	0.00	0.00	0.00
15.	TOTAL INIT EQUIP LESS LAMPS		47520.00	99200.00
16.	TOTAL INIT EQUIP INCL LAMPS	151200.00	49600.00	101600.00
II. INITIAL LABOR ESTIMATES				
18.	POLE ERECTION + PAINTING		155.00	0.00
19.	LUMINAIRE LABOR		60.00	75.00
20.	NET LABOR, POLES + LUMINAIRES	46400.00	34400.00	12000.00
21.	LABOR ELECTRICAL DISTRIBUTION	48000.00	12000.00	36000.00
21A.	LABOR STANDBY GENERATOR	6400.00	1600.00	4800.00
21B.	LABOR UPS	0.00	0.00	0.00
22.	TOTAL INITIAL LABOR	100800.00	48000.00	52800.00
23.	TOTAL INITIAL INVESTMENT	252000.00	97600.00	154400.00
III. ILLUMINATION CALCULATIONS				
25.	SPACING OR AREA		50.00	50.00
26.	UTILIZATION FACTOR		0.00	0.00
27.	MAINTENANCE FACTOR		.81	.81
28.	DESIGN FOOTCANDLES		2.00	2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	31.50	12.20	19.30

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 2 — TEST 6 1X500 1X1500W QUARTZ
50 DEGREE AIMING 50 FT SPACING
HORIZONTAL POSITION 90 135 DEGREES

	TOTAL FOR SYSTEM	500W 90 DEGREE 15 FT MTG	1500W 135 DEGREE 15 FT MTG
IV. ANNUAL COSTS			
30. KW PER LUMINAIRE		.50	1.50
30A. KW UPS POWER LOSS		0.00	0.00
31. TOTAL SYSTEM KW	320.	80.	240.
32. ANNUAL OPERATION (HOURS)		4000.	4000.
33. TOTAL ENERGY KWH/YEAR	1280000.	320000.	960000.
34. ENERGY COST PER KWH		.0200	.0200
35. DEMAND CHARGE/KW/MONTH		0.0000	0.0000
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00
37. ANNUAL KWH COST	25600.00	6400.00	19200.00
37D. DIESEL FUEL COST	512.00	128.00	384.00
38. GROUP RELAMPING PERIOD (HOURS)		1600.	1600.
38A. RATED LAMP LIFE (HOURS)		2000.	2000.
38B. PORTION OF LAMPS SPOT REPLACED		.20	.20
39. QUANTITY OF REPLACEMENT LAMPS		480.	480.
40. REPLACEMENT LAMP COST	13440.00	6240.00	7200.00
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
43. GROUP RELAMPINGS/YEAR/LUMINAIRE		2.50	2.50
43A. SPOT RELAMPINGS/YEAR/LUMINAIRE		.5000	.5000
44. RELAMPING COST - LABOR	3200.00	1600.00	1600.00
46. CLEANINGS/YEAR/LUMINAIRE		0.00	0.00
47. CLEANING COST - LABOR	0.00	0.00	0.00
48. PAINTING TIME PER POLE		0.00	0.00
50. PAINTING COST - LABOR	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	1467.20	475.20	992.00
52. TOTAL ANNUAL MAINTENANCE COST	4667.20	2075.20	2592.00
53. ANNUAL OPERATING COST	44219.20	14843.20	29376.00
54. ANNUAL OP"NG COST PER FT ~~OR ACRE~~	5.53	1.86	3.67
VI. ANNUAL OWNERSHIP + OPERATING COST			
55. FIXED OWNERSHIP COST	35147.84	13563.84	21584.00
56. ANNUAL OWNERSHIP + OP"ING COST	79367.04	28407.04	50960.00
58. TOTAL PER LINEAL FOOT ~~OR ACRE~~	9.92	3.55	6.37

U.S. ARMY CORPS OF ENGINEERS, OMAHA DI..RI

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 3

TEST 59 2X1500W QUARTZ H119 V99
70 DEGREE AIMING 120 FT SPACING
HORIZONTAL 135 _ 45 DEGREES

		TOTAL FOR SYSTEM	2X1500W 15 FT MTG
I.	INITIAL EQUIPMENT INVESTMENT		
1.	QUANTITY OF LUMINAIRES	134	134
2.	LUMINAIRE COST EACH		65.00
3.	LUMINAIRE COST TOTAL	8710.00	8710.00
4.	QUANTITY OF POLES	67	67
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		4690.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	4690.00	4690.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		134
12.	LAMP COST EACH		15.00
13.	LAMP COST TOTAL	2010.00	2010.00
14.	ELECTRICAL DISTRIBUTION	40200.00	40200.00
14A.	STANDBY GENERATOR COST	34170.00	34170.00
14C.	UPS COST	0.00	0.00
15.	TOTAL INIT EQUIP LESS LAMPS		87770.00
16.	TOTAL INIT EQUIP INCL LAMPS	89780.00	89780.00
II.	INITIAL LABOR ESTIMATES		
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		75.00
20.	NET LABOR, POLES + LUMINAIRES	20435.00	20435.00
21.	LABOR ELECTRICAL DISTRIBUTION	30150.00	30150.00
21A.	LABOR STANDBY GENERATOR	4020.00	4020.00
21B.	LABOR UPS	0.00	0.00
22.	TOTAL INITIAL LABOR	54605.00	54605.00
23.	TOTAL INITIAL INVESTMENT	298785.00	144385.00
III.	ILLUMINATION CALCULATIONS		
25.	SPACING OR AREA		120.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.81
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	17.96	17.96

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 3 — TEST 59 2X1500W QUARTZ H119 V99
70 DEGREE AIMING 120 FT SPACING
HORIZONTAL 135 _ 45 DEGREES

		TOTAL FOR SYSTEM	2X1500W 15 FT MTG
IV.	ANNUAL COSTS		
30.	KW PER LUMINAIRE		1.50
30A.	KW UPS POWER LOSS		0.00
31.	TOTAL SYSTEM KW	201.	201.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	804000.	804000.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	16080.00	16080.00
37D.	DIESEL FUEL COST	321.60	321.60
38.	GROUP RELAMPING PERIOD (HOURS)		1600.
38A.	RATED LAMP LIFE (HOURS)		2000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		402.
40.	REPLACEMENT LAMP COST	6030.00	6030.00
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		2.50
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.5000
44.	RELAMPING COST - LABOR	1340.00	1340.00
46.	CLEANINGS/YEAR/LUMINAIRE		0.00
47.	CLEANING COST - LABOR	0.00	0.00
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	877.70	877.70
52.	TOTAL ANNUAL MAINTENANCE COST	2217.70	2217.70
53.	ANNUAL OPERATING COST	24649.30	24649.30
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	3.07	3.07
VI.	ANNUAL OWNERSHIP + OPERATING COST		
55.	FIXED OWNERSHIP COST	20217.25	20217.25
56.	ANNUAL OWNERSHIP + OP"ING COST	44866.55	44866.55
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	5.58	5.58

14

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 4 — TEST 55 1X1500W QUARTZ H120 V63, 60 DEGREE AIMING 50 FT SPACING, HORIZONTAL POSITION 90 DEGREE

		TOTAL FOR SYSTEM	1X1500W 15 FT MTG
I. INITIAL EQUIPMENT INVESTMENT			
1.	QUANTITY OF LUMINAIRES	160	160
2.	LUMINAIRE COST EACH		65.00
3.	LUMINAIRE COST TOTAL	10400.00	10400.00
4.	QUANTITY OF POLES	160	160
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		11200.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	11200.00	11200.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		160
12.	LAMP COST EACH		15.00
13.	LAMP COST TOTAL	2400.00	2400.00
14.	ELECTRICAL DISTRIBUTION	48000.00	48000.00
14A.	STANDBY GENERATOR COST	40800.00	40800.00
14C.	UPS COST	0.00	0.00
15.	TOTAL INIT EQUIP LESS LAMPS		110400.00
16.	TOTAL INIT EQUIP INCL LAMPS	112800.00	112800.00
II. INITIAL LABOR ESTIMATES			
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		75.00
20.	NET LABOR, POLES + LUMINAIRES	36800.00	36800.00
21.	LABOR ELECTRICAL DISTRIBUTION	36000.00	36000.00
21A.	LABOR STANDBY GENERATOR	4800.00	4800.00
21B.	LABOR UPS	0.00	0.00
22.	TOTAL INITIAL LABOR	77600.00	77600.00
23.	TOTAL INITIAL INVESTMENT	344800.00	190400.00
III. ILLUMINATION CALCULATIONS			
25.	SPACING OR AREA		50.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.81
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	23.80	23.80

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 4 — TEST 55 1X1500W QUARTZ H120 V63, 60 DEGREE AIMING 50 FT SPACING, HORIZONTAL POSITION 90 DEGREE

		TOTAL FOR SYSTEM	1X1500W 15 FT MTG
IV.	**ANNUAL COSTS**		
30.	KW PER LUMINAIRE		1.50
30A.	KW UPS POWER LOSS		0.00
31.	TOTAL SYSTEM KW	240.	240.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	960000.	960000.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	19200.00	19200.00
37D.	DIESEL FUEL COST	384.00	384.00
38.	GROUP RELAMPING PERIOD (HOURS)		1600.
38A.	RATED LAMP LIFE (HOURS)		2000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		480.
40.	REPLACEMENT LAMP COST	7200.00	7200.00
V.	**ANNUAL MAINTENANCE, LABOR + MATERIALS**		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		2.50
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.5000
44.	RELAMPING COST - LABOR	1600.00	1600.00
46.	CLEANINGS/YEAR/LUMINAIRE		0.00
47.	CLEANING COST - LABOR	0.00	0.00
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	1104.00	1104.00
52.	TOTAL ANNUAL MAINTENANCE COST	2704.00	2704.00
53.	ANNUAL OPERATING COST	29488.00	29488.00
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	3.69	3.69
VI.	**ANNUAL OWNERSHIP + OPERATING COST**		
55.	FIXED OWNERSHIP COST	26696.00	26696.00
56.	ANNUAL OWNERSHIP + OP"ING COST	56184.00	56184.00
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	7.02	7.02

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTR

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 5 — TEST 42 3X500W QUARTZ H100 V93
65 DEGREE AIMING 70 FT SPACING
HORIZONTAL POSITIONS 45 _ 90 _ 135 DEGREES

		TOTAL FOR SYSTEM	3X500W 15 FT MTG
I. INITIAL EQUIPMENT INVESTMENT			
1.	QUANTITY OF LUMINAIRES	345	345
2.	LUMINAIRE COST EACH		13.00
3.	LUMINAIRE COST TOTAL	4485.00	4485.00
4.	QUANTITY OF POLES	115	115
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		8050.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	8050.00	8050.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		345
12.	LAMP COST EACH		13.0[illegible]
13.	LAMP COST TOTAL	4485.00	4485.00
14.	ELECTRICAL DISTRIBUTION	34500.00	34500.00
14A.	STANDBY GENERATOR COST	29325.00	29325.00
14C.	UPS COST	0.00	0.00
15.	TOTAL INIT EQUIP LESS LAMPS		76360.00
16.	TOTAL INIT EQUIP INCL LAMPS	80845.00	80845.00
II. INITIAL LABOR ESTIMATES			
[illegible]	P[illegible] ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		60.00
20.	NET LABOR, POLES + LUMINAIRES	38525.00	38525.00
21.	LABOR ELECTRICAL DISTRIBUTION	25875.00	25875.00
21A.	LABOR STANDBY GENERATOR	3450.00	3450.00
21B.	LABOR UPS	0.00	0.00
22.	TOTAL INITIAL LABOR	67850.00	67850.00
23.	TOTAL INITIAL INVESTMENT	303095.00	148695.00
III. ILLUMINATION CALCULATIONS			
25.	SPACING OR AREA		70.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.8[illegible]
28.	DESIGN FOOTCANDLES		2.0[illegible]
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	18.47	18.47

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTR

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 5

TEST 42 3X500W QUARTZ H100 V93
65 DEGREE AIMING 70 FT SPACING
HORIZONTAL POSITIONS 45 _ 90 _ 135 DEGREES

		TOTAL FOR SYSTEM	3X500W 15 FT MTG
IV.	ANNUAL COSTS		
30.	KW PER LUMINAIRE		.50
30A.	KW UPS POWER LOSS		0.00
31.	TOTAL SYSTEM KW	173.	173.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	690000.	690000.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	13800.00	13800.00
37D.	DIESEL FUEL COST	276.00	276.00
38.	GROUP RELAMPING PERIOD (HOURS)		1600.
38A.	RATED LAMP LIFE (HOURS)		2000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		1035.
40.	REPLACEMENT LAMP COST	13455.00	13455.00
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		2.50
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.5000
44.	RELAMPING COST - LABOR	3450.00	3450.00
46.	CLEANINGS/YEAR/LUMINAIRE		0.00
47.	CLEANING COST - LABOR	0.00	0.00
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	763.60	763.60
52.	TOTAL ANNUAL MAINTENANCE COST	4213.60	4213.60
53.	ANNUAL OPERATING COST	31744.60	31744.60
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	3.94	3.94
VI.	ANNUAL OWNERSHIP + OPERATING COST		
55.	FIXED OWNERSHIP COST	20477.82	20477.82
56.	ANNUAL OWNERSHIP + OP"ING COST	52222.42	52222.42
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	6.49	6.49

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTR

ECONOMIC COMPARISION

PERIMETER	TEST 91E 1X250W HP SODIUM ROADWAY
LIGHTING	10 DEGREE AIMING 40 FT SPACING
SCHEME 6	HORIZONTAL POSITION 90 DEGREES

	TOTAL FOR SYSTEM	1X250W GITT 30 FT MTG
I. INITIAL EQUIPMENT INVESTMENT		
1. QUANTITY OF LUMINAIRES	200	200
2. LUMINAIRE COST EACH		390.00
3. LUMINAIRE COST TOTAL	78000.00	78000.00
4. QUANTITY OF POLES	200	200
5. MOUNTING HEIGHT		30.00
6. POLE + BRACKET COST EACH		390.00
7. POLE COST TOTAL		78000.00
8. FOUNDATION COST EACH		50.00
9. POLE + FOUNDATION COST TOTAL	88000.00	88000.00
10. QTY LAMPS PER LUMINAIRE		1
11. QUANTITY LAMPS		200
12. LAMP COST EACH		38.00
13. LAMP COST TOTAL	7600.00	7600.0(
14. ELECTRICAL DISTRIBUTION	14500.00	14500.00
14A. STANDBY GENERATOR COST	12325.00	12325.00
14C. UPS COST	43500.00	43500.00
15. TOTAL INIT EQUIP LESS LAMPS		236325.00
16. TOTAL INIT EQUIP INCL LAMPS	243925.00	243925.00
II. INITIAL LABOR ESTIMATES		
18. POLE ERECTION + PAINTING		162.00
19. LUMINAIRE LABOR		60.00
20. NET LABOR, POLES + LUMINAIRES	44400.00	44400.00
21. LABOR ELECTRICAL DISTRIBUTION	10875.00	10875.00
21A. LABOR STANDBY GENERATOR	1450.00	1450.00
21B. LABOR UPS	5800.00	5800.00
22. TOTAL INITIAL LABOR	62525.00	62525.00
23. TOTAL INITIAL INVESTMENT	460950.00	306450.00
III. ILLUMINATION CALCULATIONS		
25. SPACING OR AREA		40.00
26. UTILIZATION FACTOR		0.00
27. MAINTENANCE FACTOR		.72
28. DESIGN FOOTCANDLES		2.0(
29. INIT COST PER LINEAL FT ~~OR ACRE~~	38.31	38.3.

U.S. ARMY CORPS OF ENGINEERS, OMAHA DIS1

ECONOMIC COMPARISION

PERIMETER	TEST 91E 1X250W HP SODIUM ROADWAY
LIGHTING	10 DEGREE AIMING 40 FT SPACING
SCHEME 6	HORIZONTAL POSITION 90 DEGREES

		TOTAL FOR SYSTEM	1X250W GITT 30 FT MTG
IV. ANNUAL COSTS			
30.	KW PER LUMINAIRE		.29
30A.	KW UPS POWER LOSS		14.50
31.	TOTAL SYSTEM KW	73.	73.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	290000.	290000.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	5800.00	5800.00
37D.	DIESEL FUEL COST	116.00	116.00
38.	GROUP RELAMPING PERIOD (HOURS)		9500.
39A.	RATED LAMP LIFE (HOURS)		15000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		101.
40.	REPLACEMENT LAMP COST	3840.00	3840.00
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.42
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0842
44.	RELAMPING COST - LABOR	336.84	336.84
46.	CLEANINGS/YEAR/LUMINAIRE		.58
47.	CLEANING COST - LABOR	231.58	231.58
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	2363.25	2363.25
52.	TOTAL ANNUAL MAINTENANCE COST	2931.67	2931.67
53.	ANNUAL OPERATING COST	12687.67	12687.67
54.	ANNUAL OP"NG COST PER FT [redacted]	1.59	1.59
VI. ANNUAL OWNERSHIP + OPERATING COST			
55.	FIXED OWNERSHIP COST	42436.70	42436.70
56.	ANNUAL OWNERSHIP + OP"ING COST	55124.37	55124.37
58.	TOTAL PER LINEAL FOOT [redacted]	6.89	6.89

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER TEST 97 1X250 HP SODIUM
LIGHTING 60 DEGREE AIMING 60 FT SPACING
SCHEME 7 HORIZONTAL POSITION 90 DEGREES

	TOTAL FOR SYSTEM	1X250W WMWE 15 FT MTG
I. INITIAL EQUIPMENT INVESTMENT		
1. QUANTITY OF LUMINAIRES	134	134
2. LUMINAIRE COST EACH		240.00
3. LUMINAIRE COST TOTAL	32160.00	32160.00
4. QUANTITY OF POLES	134	134
5. MOUNTING HEIGHT		15.00
6. POLE + BRACKET COST EACH		70.00
7. POLE COST TOTAL		9380.00
8. FOUNDATION COST EACH		0.00
9. POLE + FOUNDATION COST TOTAL	9380.00	9380.00
10. QTY LAMPS PER LUMINAIRE		1
11. QUANTITY LAMPS		134
12. LAMP COST EACH		30.00
13. LAMP COST TOTAL	4020.00	4020.00
14. ELECTRICAL DISTRIBUTION	9715.00	9715.00
14A. STANDBY GENERATOR COST	8257.75	8257.75
14C. UPS COST	29145.00	29145.00
15. TOTAL INIT EQUIP LESS LAMPS		88657.75
16. TOTAL INIT EQUIP INCL LAMPS	92677.75	92677.75
II. INITIAL LABOR ESTIMATES		
18. POLE ERECTION + PAINTING		155.00
19. LUMINAIRE LABOR		60.00
20. NET LABOR, POLES + LUMINAIRES	28810.00	28810.00
21. LABOR ELECTRICAL DISTRIBUTION	7286.25	7286.25
21A. LABOR STANDBY GENERATOR	971.50	971.50
21B. LABOR UPS	3886.00	3886.00
22. TOTAL INITIAL LABOR	40953.75	40953.75
23. TOTAL INITIAL INVESTMENT	288031.50	133631.50
III. ILLUMINATION CALCULATIONS		
25. SPACING OR AREA		60.00
26. UTILIZATION FACTOR		0.00
27. MAINTENANCE FACTOR		.72
28. DESIGN FOOTCANDLES		2.00
29. INIT COST PER LINEAL FT ~~OR ACRE~~	16.62	16.62

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTR.

ECONOMIC COMPARISION

PERIMETER	TEST 97 1X250 HP SODIUM
LIGHTING	60 DEGREE AIMING 60 FT SPACING
SCHEME 7	HORIZONTAL POSITION 90 DEGREES

	TOTAL FOR SYSTEM	1X250W WMWE 15 FT MTG
IV. ANNUAL COSTS		
30. KW PER LUMINAIRE		.29
30A. KW UPS POWER LOSS		9.72
31. TOTAL SYSTEM KW	49.	49.
32. ANNUAL OPERATION (HOURS)		4000.
33. TOTAL ENERGY KWH/YEAR	194300.	194300.
34. ENERGY COST PER KWH		.0200
35. DEMAND CHARGE/KW/MONTH		0.0000
36. DEMAND CHARGE PER YEAR	0.00	0.00
37. ANNUAL KWH COST	3886.00	3886.00
37D. DIESEL FUEL COST	77.72	77.72
38. GROUP RELAMPING PERIOD (HOURS)		9500.
38A. RATED LAMP LIFE (HOURS)		15000.
38B. PORTION OF LAMPS SPOT REPLACED		.20
39. QUANTITY OF REPLACEMENT LAMPS		68.
40. REPLACEMENT LAMP COST	2031.16	2031.16
V. ANNUAL MAINTENANCE, LABOR + MATERIALS		
43. GROUP RELAMPINGS/YEAR/LUMINAIRE		.42
43A. SPOT RELAMPINGS/YEAR/LUMINAIRE		.0842
44. RELAMPING COST - LABOR	225.68	225.68
46. CLEANINGS/YEAR/LUMINAIRE		.58
47. CLEANING COST - LABOR	155.16	155.16
48. PAINTING TIME PER POLE		0.00
50. PAINTING COST - LABOR	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	886.58	886.58
52. TOTAL ANNUAL MAINTENANCE COST	1267.42	1267.42
53. ANNUAL OPERATING COST	7262.30	7262.30
54. ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.90	.90
VI. ANNUAL OWNERSHIP + OPERATING COST		
55. FIXED OWNERSHIP COST	18404.83	18404.83
56. ANNUAL OWNERSHIP + OP"ING COST	25667.13	25667.13
58. TOTAL PER LINEAL FOOT ~~OR ACRE~~	3.19	3.19

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 8 — TEST 98 2X250 HP SODIUM, 70 DEGREE AIMING 120 FT SPACING, HORIZONTAL POSITION 45 135 DEGREES

	TOTAL FOR SYSTEM	2X250W WMWE 15 FT MTG
I. INITIAL EQUIPMENT INVESTMENT		
1. QUANTITY OF LUMINAIRES	134	134
2. LUMINAIRE COST EACH		240.00
3. LUMINAIRE COST TOTAL	32160.00	32160.00
4. QUANTITY OF POLES	67	67
5. MOUNTING HEIGHT		15.00
6. POLE + BRACKET COST EACH		70.00
7. POLE COST TOTAL		4690.00
8. FOUNDATION COST EACH		0.00
9. POLE + FOUNDATION COST TOTAL	4690.00	4690.00
10. QTY LAMPS PER LUMINAIRE		1
11. QUANTITY LAMPS		134
12. LAMP COST EACH		38.00
13. LAMP COST TOTAL	5092.00	5092.00
14. ELECTRICAL DISTRIBUTION	9715.00	9715.00
14A. STANDBY GENERATOR COST	8257.75	8257.75
14C. UPS COST	29145.00	29145.00
15. TOTAL INIT EQUIP LESS LAMPS		83967.75
16. TOTAL INIT EQUIP INCL LAMPS	89059.75	89059.75
II. INITIAL LABOR ESTIMATES		
18. POLE ERECTION + PAINTING		155.00
19. LUMINAIRE LABOR		60.00
20. NET LABOR, POLES + LUMINAIRES	18425.00	18425.00
21. LABOR ELECTRICAL DISTRIBUTION	7286.25	7286.25
21A. LABOR STANDBY GENERATOR	971.50	971.50
21B. LABOR UPS	3886.00	3886.00
22. TOTAL INITIAL LABOR	30568.75	30568.75
23. TOTAL INITIAL INVESTMENT	274028.50	119628.50
III. ILLUMINATION CALCULATIONS		
25. SPACING OR AREA		120.00
26. UTILIZATION FACTOR		0.00
27. MAINTENANCE FACTOR		.72
28. DESIGN FOOTCANDLES		2.00
29. INIT COST PER LINEAL FT ~~OR ACRE~~	14.88	14.88

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER	TEST 98 2X250 HP SODIUM
LIGHTING	70 DEGREE AIMING 120 FT SPACING
SCHEME 8	HORIZONTAL POSITION 45 135 DEGREES

		TOTAL FOR SYSTEM	2X250W WMWE 15 FT MTG
IV.	ANNUAL COSTS		
30.	KW PER LUMINAIRE		.29
30A.	KW UPS POWER LOSS		9.72
31.	TOTAL SYSTEM KW	49.	49.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	194300.	194300.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	3886.00	3886.00
37D.	DIESEL FUEL COST	77.72	77.72
38.	GROUP RELAMPING PERIOD (HOURS)		9500.
38A.	RATED LAMP LIFE (HOURS)		15000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		68.
40.	REPLACEMENT LAMP COST	2572.80	2572.80
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.42
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0842
44.	RELAMPING COST - LABOR	225.68	225.68
46.	CLEANINGS/YEAR/LUMINAIRE		.58
47.	CLEANING COST - LABOR	155.16	155.16
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	839.68	839.68
52.	TOTAL ANNUAL MAINTENANCE COST	1220.52	1220.52
53.	ANNUAL OPERATING COST	7757.04	7757.04
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.96	.96
VI.	ANNUAL OWNERSHIP + OPERATING COST		
55.	FIXED OWNERSHIP COST	16264.18	16264.18
56.	ANNUAL OWNERSHIP + OP"ING COST	24021.22	24021.22
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	2.99	2.99

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 9 — TEST 96A 1X400 W HP SODIUM
60 DEGREE AIMING 80 FT SPACING
HORIZONTAL POSITION 90 DEGREES AIMING

		TOTAL FOR SYSTEM	1X400W WMWE 15 FT MTG
I.	**INITIAL EQUIPMENT INVESTMENT**		
1.	QUANTITY OF LUMINAIRES	100	100
2.	LUMINAIRE COST EACH		250.00
3.	LUMINAIRE COST TOTAL	25000.00	25000.00
4.	QUANTITY OF POLES	100	100
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		7000.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	7000.00	7000.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		100
12.	LAMP COST EACH		39.00
13.	LAMP COST TOTAL	3900.00	3900.00
14.	ELECTRICAL DISTRIBUTION	11500.00	11500.00
14A.	STANDBY GENERATOR COST	9775.00	9775.00
14C.	UPS COST	34500.00	34500.00
15.	TOTAL INIT EQUIP LESS LAMPS		87775.00
16.	TOTAL INIT EQUIP INCL LAMPS	91675.00	91675.00
II.	**INITIAL LABOR ESTIMATES**		
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		75.00
20.	NET LABOR, POLES + LUMINAIRES	23000.00	23000.00
21.	LABOR ELECTRICAL DISTRIBUTION	8625.00	8625.00
21A.	LABOR STANDBY GENERATOR	1150.00	1150.00
21B.	LABOR UPS	4600.00	4600.00
22.	TOTAL INITIAL LABOR	37375.00	37375.00
23.	TOTAL INITIAL INVESTMENT	283450.00	129050.00
III.	**ILLUMINATION CALCULATIONS**		
25.	SPACING OR AREA		80.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.72
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	16.13	16.13

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 9

TEST 96A 1X400 W HP SODIUM
60 DEGREE AIMING 80 FT SPACING
HORIZONTAL POSITION 90 DEGREES AIMING

	TOTAL FOR SYSTEM	1X400W WMWE 15 FT MTG
IV. ANNUAL COSTS		
30. KW PER LUMINAIRE		.46
30A. KW UPS POWER LOSS		11.50
31. TOTAL SYSTEM KW	58.	58.
32. ANNUAL OPERATION (HOURS)		4000.
33. TOTAL ENERGY KWH/YEAR	230000.	230000.
34. ENERGY COST PER KWH		.0200
35. DEMAND CHARGE/KW/MONTH		0.0000
36. DEMAND CHARGE PER YEAR	0.00	0.00
37. ANNUAL KWH COST	4600.00	4600.00
37D. DIESEL FUEL COST	92.00	92.00
38. GROUP RELAMPING PERIOD (HOURS)		13000.
38A. RATED LAMP LIFE (HOURS)		20000.
38B. PORTION OF LAMPS SPOT REPLACED		.20
39. QUANTITY OF REPLACEMENT LAMPS		37.
40. REPLACEMENT LAMP COST	1440.00	1440.00
V. ANNUAL MAINTENANCE, LABOR + MATERIALS		
43. GROUP RELAMPINGS/YEAR/LUMINAIRE		.31
43A. SPOT RELAMPINGS/YEAR/LUMINAIRE		.0615
44. RELAMPING COST - LABOR	123.08	123.08
46. CLEANINGS/YEAR/LUMINAIRE		.69
47. CLEANING COST - LABOR	138.46	138.46
48. PAINTING TIME PER POLE		0.00
50. PAINTING COST - LABOR	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	877.75	877.75
52. TOTAL ANNUAL MAINTENANCE COST	1139.29	1139.29
53. ANNUAL OPERATING COST	7271.29	7271.29
54. ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.91	.91
VI. ANNUAL OWNERSHIP + OPERATING COST		
55. FIXED OWNERSHIP COST	17771.30	17771.30
56. ANNUAL OWNERSHIP + OP"ING COST	25042.59	25042.59
58. TOTAL PER LINEAL FOOT ~~OR ACRE~~	3.13	3.13

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 10 — TEST 75A 2X90W LP SODIUM; 70 DEGREE AIMING 100 FT SPACING; HORIZONTAL POSITIONS 45 _ 135 DEGREES

		TOTAL FOR SYSTEM	2X90W WMSE 15 FT MTG
I. INITIAL EQUIPMENT INVESTMENT			
1.	QUANTITY OF LUMINAIRES	160	160
2.	LUMINAIRE COST EACH		273.00
3.	LUMINAIRE COST TOTAL	43680.00	43680.00
4.	QUANTITY OF POLES	80	80
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		5600.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	5600.00	5600.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		160
12.	LAMP COST EACH		18.00
13.	LAMP COST TOTAL	2880.00	2880.00
14.	ELECTRICAL DISTRIBUTION	5600.00	5600.00
14A.	STANDBY GENERATOR COST	4760.00	4760.00
14C.	UPS COST	16800.00	16800.00
15.	TOTAL INIT EQUIP LESS LAMPS		76440.00
16.	TOTAL INIT EQUIP INCL LAMPS	79320.00	79320.00
II. INITIAL LABOR ESTIMATES			
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		30.00
20.	NET LABOR, POLES + LUMINAIRES	17200.00	17200.00
21.	LABOR ELECTRICAL DISTRIBUTION	4200.00	4200.00
21A.	LABOR STANDBY GENERATOR	560.00	560.00
21B.	LABOR UPS	2240.00	2240.00
22.	TOTAL INITIAL LABOR	24200.00	24200.00
23.	TOTAL INITIAL INVESTMENT	257920.00	103520.00
III. ILLUMINATION CALCULATIONS			
25.	SPACING OR AREA		100.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.85
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	12.94	12.94

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 10 — TEST 75A 2X90W LP SODIUM, 70 DEGREE AIMING 100 FT SPACING, HORIZONTAL POSITIONS 45 _ 135 DEGREES

		TOTAL FOR SYSTEM	2X90W WMSE 15 FT MTG
IV. ANNUAL COSTS			
30.	KW PER LUMINAIRE		.14
30A.	KW UPS POWER LOSS		5.60
31.	TOTAL SYSTEM KW	28.	28.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	112000.	112000.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	2240.00	2240.00
37D.	DIESEL FUEL COST	44.80	44.80
38.	GROUP RELAMPING PERIOD (HOURS)		15000.
38A.	RATED LAMP LIFE (HOURS)		18000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		51.
40.	REPLACEMENT LAMP COST	921.60	921.60
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533
44.	RELAMPING COST - LABOR	170.67	170.67
46.	CLEANINGS/YEAR/LUMINAIRE		.73
47.	CLEANING COST - LABOR	234.67	234.67
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	764.40	764.40
52.	TOTAL ANNUAL MAINTENANCE COST	1169.73	1169.73
53.	ANNUAL OPERATING COST	4376.13	4376.13
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.55	.55
VI. ANNUAL OWNERSHIP + OPERATING COST			
55.	FIXED OWNERSHIP COST	14290.88	14290.88
56.	ANNUAL OWNERSHIP + OP"ING COST	18667.01	18667.01
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	2.33	2.33

ECONOMIC COMPARISION

PERIMETER	TEST 75A 2X90W LP SODIUM
LIGHTING	70 DEGREE AIMING 100 FT SPACING
SCHEME 11	HORIZONTAL POSITION 45 _ 135 DEGREES

		TOTAL FOR SYSTEM	2X90W WWNO 15 FT MTG
I. INITIAL EQUIPMENT INVESTMENT			
1.	QUANTITY OF LUMINAIRES	160	160
2.	LUMINAIRE COST EACH		308.00
3.	LUMINAIRE COST TOTAL	49280.00	49280.00
4.	QUANTITY OF POLES	80	80
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		5600.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	5600.00	5600.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		160
12.	LAMP COST EACH		18.00
13.	LAMP COST TOTAL	2880.00	2880.00
14.	ELECTRICAL DISTRIBUTION	5600.00	5600.00
14A.	STANDBY GENERATOR COST	4760.00	4760.00
14C.	UPS COST	16800.00	16800.00
15.	TOTAL INIT EQUIP LESS LAMPS		82040.00
16.	TOTAL INIT EQUIP INCL LAMPS	84920.00	84920.00
II. INITIAL LABOR ESTIMATES			
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		30.00
20.	NET LABOR, POLES + LUMINAIRES	17200.00	17200.00
21.	LABOR ELECTRICAL DISTRIBUTION	4200.00	4200.00
21A.	LABOR STANDBY GENERATOR	560.00	560.00
21B.	LABOR UPS	2240.00	2240.00
22.	TOTAL INITIAL LABOR	24200.00	24200.00
23.	TOTAL INITIAL INVESTMENT	263520.00	109120.00
III. ILLUMINATION CALCULATIONS			
25.	SPACING OR AREA		100.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.85
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	13.64	13.64

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER — TEST 75A 2X90W LP SODIUM
LIGHTING — 70 DEGREE AIMING 100 FT SPACING
SCHEME 11 — HORIZONTAL POSITION 45 _ 135 DEGREES

		TOTAL FOR SYSTEM	2X90W WWNO 15 FT MTG
IV.	ANNUAL COSTS		
30.	KW PER LUMINAIRE		.14
30A.	KW UPS POWER LOSS		5.60
31.	TOTAL SYSTEM KW	28.	28.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	112000.	112000.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	2240.00	2240.00
37D.	DIESEL FUEL COST	44.80	44.80
38.	GROUP RELAMPING PERIOD (HOURS)		15000.
38A.	RATED LAMP LIFE (HOURS)		18000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		51.
40.	REPLACEMENT LAMP COST	921.60	921.60
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533
44.	RELAMPING COST - LABOR	170.67	170.67
46.	CLEANINGS/YEAR/LUMINAIRE		.73
47.	CLEANING COST - LABOR	234.67	234.67
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	820.40	820.40
52.	TOTAL ANNUAL MAINTENANCE COST	1225.73	1225.73
53.	ANNUAL OPERATING COST	4432.13	4432.13
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.55	.55
VI.	ANNUAL OWNERSHIP + OPERATING COST		
55.	FIXED OWNERSHIP COST	15086.08	15086.08
56.	ANNUAL OWNERSHIP + OP"ING COST	19518.21	19518.21
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	2.44	2.44

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER	TEST 76 1X180W LP SODIUM
LIGHTING	65 DEGREE AIMING 60 FT SPACING
SCHEME 12	HORIZONTAL POSITION [illegible] DEGREES

		TOTAL FOR SYSTEM	1X180W WMSE 75 FT MTG
I.	INITIAL EQUIPMENT INVESTMENT		
1.	QUANTITY OF LUMINAIRES	134	134
2.	LUMINAIRE COST EACH		360.00
3.	LUMINAIRE COST TOTAL	48240.00	48240.00
4.	QUANTITY OF POLES	134	134
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		9380.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	9380.00	9380.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		134
12.	LAMP COST EACH		33.00
13.	LAMP COST TOTAL	4422.00	4422.00
14.	ELECTRICAL DISTRIBUTION	8040.00	8040.00
14A.	STANDBY GENERATOR COST	6834.00	6834.00
14C.	UPS COST	24120.00	24120.00
15.	TOTAL INIT EQUIP LESS LAMPS		96614.00
16.	TOTAL INIT EQUIP INCL LAMPS	101036.00	101036.00
II.	INITIAL LABOR ESTIMATES		
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		75.00
20.	NET LABOR, POLES + LUMINAIRES	30820.00	30820.00
21.	LABOR ELECTRICAL DISTRIBUTION	6030.00	6030.00
21A.	LABOR STANDBY GENERATOR	804.00	804.00
21B.	LABOR UPS	3216.00	3216.00
22.	TOTAL INITIAL LABOR	40870.00	40870.00
23.	TOTAL INITIAL INVESTMENT	296306.00	141906.00
III.	ILLUMINATION CALCULATIONS		
25.	SPACING OR AREA		60.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.85
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	17.65	17.65

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTR.

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 12 — TEST 76 1X180W LP SODIUM, 65 DEGREE AIMING 60 FT SPACING, HORIZONTAL POSITION ~~111~~ DEGREES

		TOTAL FOR SYSTEM	1X180W WMSE 75 FT MTG
IV.	ANNUAL COSTS		
30.	KW PER LUMINAIRE		.24
30A.	KW UPS POWER LOSS		8.04
31.	TOTAL SYSTEM KW	40.	40.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	160800.	160800.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	3216.00	3216.00
37D.	DIESEL FUEL COST	64.32	64.32
38.	GROUP RELAMPING PERIOD (HOURS)		15000.
38A.	RATED LAMP LIFE (HOURS)		18000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		43.
40.	REPLACEMENT LAMP COST	1415.04	1415.04
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533
44.	RELAMPING COST - LABOR	142.93	142.93
46.	CLEANINGS/YEAR/LUMINAIRE		.73
47.	CLEANING COST - LABOR	196.53	196.53
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	966.14	966.14
52.	TOTAL ANNUAL MAINTENANCE COST	1305.61	1305.61
53.	ANNUAL OPERATING COST	6000.97	6000.97
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.75	.75
VI.	ANNUAL OWNERSHIP + OPERATING COST		
55.	FIXED OWNERSHIP COST	19522.73	19522.73
56.	ANNUAL OWNERSHIP + OP"ING COST	25523.69	25523.69
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	3.17	3.17

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTR

ECONOMIC COMPARISION

PERIMETER	TEST 95 2X180W LP SODIUM
LIGHTING	70 DEGREE AIMING 120 FT SPACING
SCHEME 13	HORIZONTAL POSITION 45 135 DEGREES

		TOTAL FOR SYSTEM	2X180W WWNO 15 FT MTG
I.	INITIAL EQUIPMENT INVESTMENT		
1.	QUANTITY OF LUMINAIRES	134	134
2.	LUMINAIRE COST EACH		339.00
3.	LUMINAIRE COST TOTAL	45426.00	45426.00
4.	QUANTITY OF POLES	67	67
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		4690.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	4690.00	4690.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		134
12.	LAMP COST EACH		33.00
13.	LAMP COST TOTAL	4422.00	4422.0
14.	ELECTRICAL DISTRIBUTION	8040.00	8040.00
14A.	STANDBY GENERATOR COST	6834.00	6834.00
14C.	UPS COST	24120.00	24120.00
15.	TOTAL INIT EQUIP LESS LAMPS		89110.00
16.	TOTAL INIT EQUIP INCL LAMPS	93532.00	93532.00
II.	INITIAL LABOR ESTIMATES		
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		75.00
20.	NET LABOR, POLES + LUMINAIRES	20435.00	20435.00
21.	LABOR ELECTRICAL DISTRIBUTION	6030.00	6030.00
21A.	LABOR STANDBY GENERATOR	804.00	804.00
21B.	LABOR UPS	3216.00	3216.00
22.	TOTAL INITIAL LABOR	30485.00	30485.00
23.	TOTAL INITIAL INVESTMENT	278417.00	124017.00
III.	ILLUMINATION CALCULATIONS		
25.	SPACING OR AREA		120.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.85
28.	DESIGN FOOTCANDLES		2.0[illegible]
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	15.43	15.4[illegible]

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

PERIMETER	TEST 95 2X180W LP SODIUM
LIGHTING	70 DEGREE AIMING 120 FT SPACING
SCHEME 13	HORIZONTAL POSITION 45 135 DEGREES

		TOTAL FOR SYSTEM	2X180W WWNO 15 FT MTG
IV.	ANNUAL COSTS		
30.	KW PER LUMINAIRE		.24
30A.	KW UPS POWER LOSS		8.04
31.	TOTAL SYSTEM KW	40.	40.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	160800.	160800.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	3216.00	3216.00
37D.	DIESEL FUEL COST	64.32	64.32
38.	GROUP RELAMPING PERIOD (HOURS)		15000.
38A.	RATED LAMP LIFE (HOURS)		18000.
38B.	PORTION OF LAMPS SPOT REPLACED		.02
39.	QUANTITY OF REPLACEMENT LAMPS		36.
40.	REPLACEMENT LAMP COST	1202.78	1202.78
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0053
44.	RELAMPING COST - LABOR	110.77	110.77
46.	CLEANINGS/YEAR/LUMINAIRE		.73
47.	CLEANING COST - LABOR	196.53	196.53
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	891.10	891.10
52.	TOTAL ANNUAL MAINTENANCE COST	1198.41	1198.41
53.	ANNUAL OPERATING COST	5681.51	5681.51
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.71	.71
VI.	ANNUAL OWNERSHIP + OPERATING COST		
55.	FIXED OWNERSHIP COST	16982.49	16982.49
56.	ANNUAL OWNERSHIP + OP"NG COST	22664.00	22664.00
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	2.82	2.82

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI(

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 14 — TEST 94 2X180W LP SODIUM 70 DEGREE AIMING 120 FT SPACING HORIZONTAL POSITION 45 _ 135 DEGREES

	TOTAL FOR SYSTEM	2X180W WMSE 15 FT MTG
I. INITIAL EQUIPMENT INVESTMENT		
1. QUANTITY OF LUMINAIRES	134	134
2. LUMINAIRE COST EACH		360.00
3. LUMINAIRE COST TOTAL	48240.00	48240.00
4. QUANTITY OF POLES	67	67
5. MOUNTING HEIGHT		15.00
6. POLE + BRACKET COST EACH		70.00
7. POLE COST TOTAL		4690.00
8. FOUNDATION COST EACH		0.00
9. POLE + FOUNDATION COST TOTAL	4690.00	4690.00
10. QTY LAMPS PER LUMINAIRE		1
11. QUANTITY LAMPS		134
12. LAMP COST EACH		33.00
13. LAMP COST TOTAL	4422.00	4422.00
14. ELECTRICAL DISTRIBUTION	8040.00	8040.00
14A. STANDBY GENERATOR COST	6834.00	6834.00
14C. UPS COST	24120.00	24120.00
15. TOTAL INIT EQUIP LESS LAMPS		91924.00
16. TOTAL INIT EQUIP INCL LAMPS	96346.00	96346.00
II. INITIAL LABOR ESTIMATES		
18. POLE ERECTION + PAINTING		155.00
19. LUMINAIRE LABOR		75.00
20. NET LABOR, POLES + LUMINAIRES	20435.00	20435.00
21. LABOR ELECTRICAL DISTRIBUTION	6030.00	6030.00
21A. LABOR STANDBY GENERATOR	804.00	804.00
21B. LABOR UPS	3216.00	3216.00
22. TOTAL INITIAL LABOR	30485.00	30485.00
23. TOTAL INITIAL INVESTMENT	281231.00	126831.00
III. ILLUMINATION CALCULATIONS		
25. SPACING OR AREA		120.00
26. UTILIZATION FACTOR		0.00
27. MAINTENANCE FACTOR		.85
28. DESIGN FOOTCANDLES		2.00
29. INIT COST PER LINEAL FT ~~OR ACRE~~	15.78	15.78

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 14 — TEST 94 2X180W LP SODIUM 70 DEGREE AIMING 120 FT SPACING HORIZONTAL POSITION 45 135 DEGREES

		TOTAL FOR SYSTEM	2X180W WMSE 15 FT MTG
IV. ANNUAL COSTS			
30.	KW PER LUMINAIRE		.24
30A.	KW UPS POWER LOSS		8.04
31.	TOTAL SYSTEM KW	40.	40.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	160800.	160800.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	3216.00	3216.00
37D.	DIESEL FUEL COST	64.32	64.32
38.	GROUP RELAMPING PERIOD (HOURS)		15000.
38A.	RATED LAMP LIFE (HOURS)		18000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		43.
40.	REPLACEMENT LAMP COST	1415.04	1415.04
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533
44.	RELAMPING COST - LABOR	142.93	142.93
46.	CLEANINGS/YEAR/LUMINAIRE		.73
47.	CLEANING COST - LABOR	196.53	196.53
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	919.24	919.24
52.	TOTAL ANNUAL MAINTENANCE COST	1258.71	1258.71
53.	ANNUAL OPERATING COST	5954.07	5954.07
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.74	.74
VI. ANNUAL OWNERSHIP + OPERATING COST			
55.	FIXED OWNERSHIP COST	17382.08	17382.08
56.	ANNUAL OWNERSHIP + OP"ING COST	23336.14	23336.14
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	2.90	2.90

U.S. ARMY CORPS OF ENGINEERS, OMAHA DIST

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 15 — TEST 53 3X180 W LP SODIUM, 20 DEGREE AIMING 120 FT SPACING, HORIZONTAL POSITION 90 DEGREES

	TOTAL FOR SYSTEM	3X180W WGQV 30 FT MTG
I. INITIAL EQUIPMENT INVESTMENT		
1. QUANTITY OF LUMINAIRES	201	201
2. LUMINAIRE COST EACH		250.00
3. LUMINAIRE COST TOTAL	50250.00	50250.00
4. QUANTITY OF POLES	67	67
5. MOUNTING HEIGHT		15.00
6. POLE + BRACKET COST EACH		130.00
7. POLE COST TOTAL		8710.00
8. FOUNDATION COST EACH		0.00
9. POLE + FOUNDATION COST TOTAL	8710.00	8710.00
10. QTY LAMPS PER LUMINAIRE		1
11. QUANTITY LAMPS		201
12. LAMP COST EACH		33.00
13. LAMP COST TOTAL	6633.00	6633.00
14. ELECTRICAL DISTRIBUTION	12060.00	12060.
14A. STANDBY GENERATOR COST	10251.00	10251.00
14C. UPS COST	36180.00	36180.00
15. TOTAL INIT EQUIP LESS LAMPS		117451.00
16. TOTAL INIT EQUIP INCL LAMPS	124084.00	124084.00
II. INITIAL LABOR ESTIMATES		
18. POLE ERECTION + PAINTING		162.00
19. LUMINAIRE LABOR		75.00
20. NET LABOR, POLES + LUMINAIRES	25929.00	25929.00
21. LABOR ELECTRICAL DISTRIBUTION	9045.00	9045.00
21A. LABOR STANDBY GENERATOR	1206.00	1206.00
21B. LABOR UPS	4824.00	4824.00
22. TOTAL INITIAL LABOR	41004.00	41004.00
23. TOTAL INITIAL INVESTMENT	319488.00	165088.00
III. ILLUMINATION CALCULATIONS		
25. SPACING OR AREA		120.00
26. UTILIZATION FACTOR		0.00
27. MAINTENANCE FACTOR		.85
28. DESIGN FOOTCANDLES		2.00
29. INIT COST PER LINEAL FT ~~OR ACRE~~	20.53	20.53

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER	TEST 53 3X180 W LP SODIUM
LIGHTING	20 DEGREE AIMING 120 FT SPACING
SCHEME 15	HORIZONTAL POSITION 90 DEGREES

		TOTAL FOR SYSTEM	3X180W WGQV 30 FT MTG
IV. ANNUAL COSTS			
30.	KW PER LUMINAIRE		.24
30A.	KW UPS POWER LOSS		12.06
31.	TOTAL SYSTEM KW	60.	60.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	241200.	241200.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	4824.00	4824.00
37D.	DIESEL FUEL COST	96.48	96.48
38.	GROUP RELAMPING PERIOD (HOURS)		15000.
38A.	RATED LAMP LIFE (HOURS)		18000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		64.
40.	REPLACEMENT LAMP COST	2122.56	2122.56
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533
44.	RELAMPING COST - LABOR	214.40	214.40
46.	CLEANINGS/YEAR/LUMINAIRE		.73
47.	CLEANING COST - LABOR	294.80	294.80
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
5[illegible].	REPLACEMENT PARTS, PAINT, ETC.	1174.51	1174.51
[illegible].	TOTAL ANNUAL MAINTENANCE COST	1683.71	1683.71
53.	ANNUAL OPERATING COST	8726.75	8726.75
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	1.09	1.09
VI. ANNUAL OWNERSHIP + OPERATING COST			
55.	FIXED OWNERSHIP COST	22500.61	22500.61
56.	ANNUAL OWNERSHIP + OP"ING COST	31227.36	31227.36
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	3.88	3.88

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

PERIMETER	TEST 80F 1X180 W LP SODIUM
LIGHTING	20 DEGREE AIMING 70 FT SPACING
SCHEME 16	HORIZONTAL POSITION 90 DEGREES

		TOTAL FOR SYSTEM	1X180W WGQV 15 FT MTG
I.	INITIAL EQUIPMENT INVESTMENT		
1.	QUANTITY OF LUMINAIRES	115	115
2.	LUMINAIRE COST EACH		250.00
3.	LUMINAIRE COST TOTAL	28750.00	28750.00
4.	QUANTITY OF POLES	115	115
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		8050.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	8050.00	8050.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		115
12.	LAMP COST EACH		33.00
13.	LAMP COST TOTAL	3795.00	3795.00
14.	ELECTRICAL DISTRIBUTION	6900.00	6900.00
14A.	STANDBY GENERATOR COST	5865.00	5865.00
14C.	UPS COST	20700.00	20700.00
15.	TOTAL INIT EQUIP LESS LAMPS		70265.00
16.	TOTAL INIT EQUIP INCL LAMPS	74060.00	74060.00
II.	INITIAL LABOR ESTIMATES		
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		75.00
20.	NET LABOR, POLES + LUMINAIRES	26450.00	26450.00
21.	LABOR ELECTRICAL DISTRIBUTION	5175.00	5175.00
21A.	LABC STANDBY GENERATOR	690.00	690.00
21B.	LABOR UPS	2760.00	2760.00
22.	TOTAL INITIAL LABOR	35075.00	35075.00
23.	TOTAL INITIAL INVESTMENT	263535.00	109135.00
III.	ILLUMINATION CALCULATIONS		
25.	SPACING OR AREA		70.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.85
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	13.56	13.56

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 16

TEST 80F 1X180 W LP SODIUM
20 DEGREE AIMING 70 FT SPACING
HORIZONTAL POSITION 90 DEGREES

		TOTAL FOR SYSTEM	1X180W WGQV 15 FT MTG
IV.	**ANNUAL COSTS**		
30.	KW PER LUMINAIRE		.24
30A.	KW UPS POWER LOSS		6.90
31.	TOTAL SYSTEM KW	35.	35.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	138000.	138000.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	2760.00	2760.00
37D.	DIESEL FUEL COST	55.20	55.20
38.	GROUP RELAMPING PERIOD (HOURS)		15000.
38A.	RATED LAMP LIFE (HOURS)		18000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		37.
40.	REPLACEMENT LAMP COST	1214.40	1214.40
V.	**ANNUAL MAINTENANCE, LABOR + MATERIALS**		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533
44.	RELAMPING COST - LABOR	122.67	122.67
46.	CLEANINGS/YEAR/LUMINAIRE		.73
47.	CLEANING COST - LABOR	168.67	168.67
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	702.65	702.65
52.	TOTAL ANNUAL MAINTENANCE COST	993.98	993.98
53.	ANNUAL OPERATING COST	5023.58	5023.58
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.62	.62
VI.	**ANNUAL OWNERSHIP + OPERATING COST**		
55.	FIXED OWNERSHIP COST	14958.28	14958.28
56.	ANNUAL OWNERSHIP + OP"ING COST	19981.86	19981.86
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	2.48	2.48

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI(

ECONOMIC COMPARISION

PERIMETER	TEST 81 2X180W LP SODIUM
LIGHTING	20 DEGREES AIMING 100 FT SPACING
SCHEME 17	HORIZONTAL POSITION 90 DEGREES

		TOTAL FOR SYSTEM	2X180W WGQV 15 FT MTG
I.	INITIAL EQUIPMENT INVESTMENT		
1.	QUANTITY OF LUMINAIRES	160	160
2.	LUMINAIRE COST EACH		250.00
3.	LUMINAIRE COST TOTAL	40000.00	40000.00
4.	QUANTITY OF POLES	80	80
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		5600.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	5600.00	5600.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		160
12.	LAMP COST EACH		33.00
13.	LAMP COST TOTAL	5280.00	5280.00
14.	ELECTRICAL DISTRIBUTION	9600.00	9600.00
14A.	STANDBY GENERATOR COST	8160.00	8160.00
14C.	UPS COST	28800.00	28800.00
15.	TOTAL INIT EQUIP LESS LAMPS		92160.00
16.	TOTAL INIT EQUIP INCL LAMPS	97440.00	97440.00
II.	INITIAL LABOR ESTIMATES		
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		75.00
20.	NET LABOR, POLES + LUMINAIRES	24400.00	24400.00
21.	LABOR ELECTRICAL DISTRIBUTION	7200.00	7200.00
21A.	LABOR STANDBY GENERATOR	960.00	960.00
21B.	LABOR UPS	3840.00	3840.00
22.	TOTAL INITIAL LABOR	36400.00	36400.00
23.	TOTAL INITIAL INVESTMENT	288240.00	133840.00
III.	ILLUMINATION CALCULATIONS		
25.	SPACING OR AREA		100.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.85
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	16.73	16.73

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER	TEST 81 2X180W LP SODIUM
LIGHTING	20 DEGREES AIMING 100 FT SPACING
SCHEME 17	HORIZONTAL POSITION 90 DEGREES

		TOTAL FOR SYSTEM	2X180W WGQV 15 FT MTG
IV.	ANNUAL COSTS		
30.	KW PER LUMINAIRE		.24
30A.	KW UPS POWER LOSS		9.60
31.	TOTAL SYSTEM KW	48.	48.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	192000.	192000.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	3840.00	3840.00
37D.	DIESEL FUEL COST	76.80	76.80
38.	GROUP RELAMPING PERIOD (HOURS)		15000.
38A.	RATED LAMP LIFE (HOURS)		18000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		51.
40.	REPLACEMENT LAMP COST	1689.60	1689.60
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533
44.	RELAMPING COST - LABOR	170.67	170.67
46.	CLEANINGS/YEAR/LUMINAIRE		.73
47.	CLEANING COST - LABOR	234.67	234.67
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	921.60	921.60
52.	TOTAL ANNUAL MAINTENANCE COST	1326.93	1326.93
53.	ANNUAL OPERATING COST	6933.33	6933.33
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.87	.87
VI.	ANNUAL OWNERSHIP + OPERATING COST		
55.	FIXED OWNERSHIP COST	18255.52	18255.52
56.	ANNUAL OWNERSHIP + OP"ING COST	25188.85	25188.85
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	3.15	3.15

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 18 — HIGH PRESSURE SODIUM WITHOUT UPS OR QUARTZ BACKUP

		TOTAL FOR SYSTEM	2X250W HPS 120 FT SP SCHEME 8
I.	INITIAL EQUIPMENT INVESTMENT		
1.	QUANTITY OF LUMINAIRES	134	134
2.	LUMINAIRE COST EACH		240.00
3.	LUMINAIRE COST TOTAL	32160.00	32160.00
4.	QUANTITY OF POLES	67	67
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		4690.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	4690.00	4690.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		134
12.	LAMP COST EACH		38.00
13.	LAMP COST TOTAL	5092.00	5092.00
14.	ELECTRICAL DISTRIBUTION	7772.00	7772.00
14A.	STANDBY GENERATOR COST	6606.20	6606.20
14C.	UPS COST	0.00	0.00
15.	TOTAL INIT EQUIP LESS LAMPS		51228.20
16.	TOTAL INIT EQUIP INCL LAMPS	56320.20	56320.20
II.	INITIAL LABOR ESTIMATES		
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		60.00
20.	NET LABOR, POLES + LUMINAIRES	18425.00	18425.00
21.	LABOR ELECTRICAL DISTRIBUTION	5829.00	5829.00
21A.	LABOR STANDBY GENERATOR	777.20	777.20
21B.	LABOR UPS	0.00	0.00
22.	TOTAL INITIAL LABOR	25031.20	25031.20
23.	TOTAL INITIAL INVESTMENT	235751.40	81351.40
III.	ILLUMINATION CALCULATIONS		
25.	SPACING OR AREA		120.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.72
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	10.12	10.12

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTR

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 18 — HIGH PRESSURE SODIUM WITHOUT UPS OR QUARTZ BACKUP

		TOTAL FOR SYSTEM	2X250W HPS 120 FT SP SCHEME 8
IV.	ANNUAL COSTS		
30.	KW PER LUMINAIRE		.29
30A.	KW UPS POWER LOSS		0.00
31.	TOTAL SYSTEM KW	39.	39.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	155440.	155440.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	3108.80	3108.80
37D.	DIESEL FUEL COST	62.18	62.18
38.	GROUP RELAMPING PERIOD (HOURS)		9500.
38A.	RATED LAMP LIFE (HOURS)		15000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		68.
40.	REPLACEMENT LAMP COST	2572.80	2572.80
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.42
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0842
44.	RELAMPING COST - LABOR	225.68	225.68
46.	CLEANINGS/YEAR/LUMINAIRE		.58
47.	CLEANING COST - LABOR	155.16	155.16
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	512.28	512.28
52.	TOTAL ANNUAL MAINTENANCE COST	893.12	893.12
53.	ANNUAL OPERATING COST	6636.90	6636.90
54.	ANNUAL OP'NG COST PER FT ~~OR ACRE~~	.83	.83
VI.	ANNUAL OWNERSHIP + OPERATING COST		
55.	FIXED OWNERSHIP COST	10828.83	10828.83
56.	ANNUAL OWNERSHIP + OP'ING COST	17465.73	17465.73
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	2.17	2.17

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 19 — HIGH PRESSURE SODIUM W/O UPS PLUS 100 PERCENT QUARTZ BACKUP SCHEME 18 PLUS SCHEME 3

	TOTAL FOR SYSTEM	2X250W HP 120 FT SP	2X1500W QUARTZ 120 FT SP
I. INITIAL EQUIPMENT INVESTMENT			
1. QUANTITY OF LUMINAIRES	268	134	134
2. LUMINAIRE COST EACH		240.00	65.00
3. LUMINAIRE COST TOTAL	40870.00	32160.00	8710.00
4. QUANTITY OF POLES	67	67	0
5. MOUNTING HEIGHT		15.00	15.00
6. POLE + BRACKET COST EACH		70.00	0.00
7. POLE COST TOTAL		4690.00	0.00
8. FOUNDATION COST EACH		0.00	0.00
9. POLE + FOUNDATION COST TOTAL	4690.00	4690.00	0.00
10. QTY LAMPS PER LUMINAIRE		1	1
11. QUANTITY LAMPS		134	134
12. LAMP COST EACH		38.00	15.00
13. LAMP COST TOTAL	7102.00	5092.00	2010.00
14. ELECTRICAL DISTRIBUTION	47972.00	7772.00	40200.00
14A. STANDBY GENERATOR COST	40776.20	6606.20	34170.00
14C. UPS COST	0.00	0.00	0.00
15. TOTAL INIT EQUIP LESS LAMPS		51228.20	83080.00
16. TOTAL INIT EQUIP INCL LAMPS	141410.20	56320.20	85090.00
II. INITIAL LABOR ESTIMATES			
18. POLE ERECTION + PAINTING		155.00	0.00
19. LUMINAIRE LABOR		60.00	75.00
20. NET LABOR, POLES + LUMINAIRES	28475.00	18425.00	10050.00
21. LABOR ELECTRICAL DISTRIBUTION	35979.00	5829.00	30150.00
21A. LABOR STANDBY GENERATOR	4797.20	777.20	4020.00
21B. LABOR UPS	0.00	0.00	0.00
22. TOTAL INITIAL LABOR	69251.20	25031.20	44220.00
23. TOTAL INITIAL INVESTMENT	210661.40	81351.40	129310.00
III. ILLUMINATION CALCULATIONS			
25. SPACING OR AREA		120.00	120.00
26. UTILIZATION FACTOR		0.00	0.00
27. MAINTENANCE FACTOR		.72	.81
28. DESIGN FOOTCANDLES		2.00	2.00
29. INIT COST PER LINEAL FT ~~OR ACRE~~	26.20	10.12	16.08

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 19 — HIGH PRESSURE SODIUM W/O UPS PLUS 100 PERCENT QUARTZ BACKUP SCHEME 15 PLUS SCHEME 3

	TOTAL FOR SYSTEM	2X250W HP 120 FT SP	2X1500W QUARTZ 120 FT SP
IV. ANNUAL COSTS			
30. KW PER LUMINAIRE		.29	1.50
30A. KW UPS POWER LOSS		0.00	0.00
31. TOTAL SYSTEM KW	240.	39.	201.
32. ANNUAL OPERATION (HOURS)		4000.	20.
33. TOTAL ENERGY KWH/YEAR	159460.	155440.	4020.
34. ENERGY COST PER KWH		.0200	.0200
35. DEMAND CHARGE/KW/MONTH		0.0000	0.0000
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00
37. ANNUAL KWH COST	3189.20	3108.80	80.40
37D. DIESEL FUEL COST	383.78	62.18	321.60
38. GROUP RELAMPING PERIOD (HOURS)		9500.	1600.
38A. RATED LAMP LIFE (HOURS)		15000.	2000.
38B. PORTION OF LAMPS SPOT REPLACED		.20	.20
39. QUANTITY OF REPLACEMENT LAMPS		68.	2.
40. REPLACEMENT LAMP COST	2602.95	2572.80	30.15
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
43. GROUP RELAMPINGS/YEAR/LUMINAIRE		.42	.01
43A. SPOT RELAMPINGS/YEAR/LUMINAIRE		.0842	.0025
44. RELAMPING COST - LABOR	232.38	225.68	6.70
46. CLEANINGS/YEAR/LUMINAIRE		.58	.99
47. CLEANING COST - LABOR	419.81	155.16	264.65
48. PAINTING TIME PER POLE		0.00	0.00
50. PAINTING COST - LABOR	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	1343.08	512.28	830.80
52. TOTAL ANNUAL MAINTENANCE COST	1995.27	893.12	1102.15
53. ANNUAL OPERATING COST	8171.20	6636.90	1534.30
54. ANNUAL OP"NG COST PER FT ~~OR ACRE~~	1.02	.83	.19
VI. ANNUAL OWNERSHIP + OPERATING COST			
55. FIXED OWNERSHIP COST	28905.43	10828.83	18076.60
56. ANNUAL OWNERSHIP + OP"ING COST	37076.63	17465.73	19610.90
58. TOTAL PER LINEAL FOOT ~~OR ACRE~~	4.61	2.17	2.44

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 20 — HIGH PRESSURE SODIUM W/O UPS PLUS 75 PERCENT QUARTZ BACKUP

	TOTAL FOR SYSTEM	2X250W HPS 120 FT SP	2X1000W Q 120 FT SP
I. INITIAL EQUIPMENT INVESTMENT			
1. QUANTITY OF LUMINAIRES	268	134	134
2. LUMINAIRE COST EACH		240.00	65.00
3. LUMINAIRE COST TOTAL	40870.00	32160.00	8710.00
4. QUANTITY OF POLES	67	67	0
5. MOUNTING HEIGHT		15.00	15.00
6. POLE + BRACKET COST EACH		70.00	0.00
7. POLE COST TOTAL		4690.00	0.00
8. FOUNDATION COST EACH		0.00	0.00
9. POLE + FOUNDATION COST TOTAL	4690.00	4690.00	0.00
10. QTY LAMPS PER LUMINAIRE		1	1
11. QUANTITY LAMPS		134	134
12. LAMP COST EACH		38.00	14.00
13. LAMP COST TOTAL	6968.00	5092.00	1876.00
14. ELECTRICAL DISTRIBUTION	34572.00	7772.00	26800.00
14A. STANDBY GENERATOR COST	29386.20	6606.20	22780.00
14C. UPS COST	0.00	0.00	0.00
15. TOTAL INIT EQUIP LESS LAMPS		51228.20	58290.00
16. TOTAL INIT EQUIP INCL LAMPS	116486.20	56320.20	60166.00
II. INITIAL LABOR ESTIMATES			
18. POLE ERECTION + PAINTING		155.00	0.00
19. LUMINAIRE LABOR		60.00	75.00
20. NET LABOR, POLES + LUMINAIRES	28475.00	18425.00	10050.00
21. LABOR ELECTRICAL DISTRIBUTION	25929.00	5829.00	20100.00
21A. LABOR STANDBY GENERATOR	3457.20	777.20	2680.00
21B. LABOR UPS	0.00	0.00	0.00
22. TOTAL INITIAL LABOR	57861.20	25031.20	32830.00
23. TOTAL INITIAL INVESTMENT	174347.40	81351.40	92996.00
III. ILLUMINATION CALCULATIONS			
25. SPACING OR AREA		120.00	120.00
26. UTILIZATION FACTOR		0.00	0.00
27. MAINTENANCE FACTOR		.72	.81
28. DESIGN FOOTCANDLES		2.00	2.00
29. INIT COST PER LINEAL FT ~~OR ACRE~~	21.69	10.12	11.57

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 20 — HIGH PRESSURE SODIUM W/O UPS PLUS 75 PERCENT QUARTZ BACKUP

	TOTAL FOR SYSTEM	2X250W HPS 120 FT SP	2X1000W Q 120 FT SP
IV. ANNUAL COSTS			
30. KW PER LUMINAIRE		.29	1.00
30A. KW UPS POWER LOSS		0.00	0.00
31. TOTAL SYSTEM KW	173.	39.	134.
32. ANNUAL OPERATION (HOURS)		4000.	20.
33. TOTAL ENERGY KWH/YEAR	158120.	155440.	2680.
34. ENERGY COST PER KWH		.0200	0.0000
35. DEMAND CHARGE/KW/MONTH		0.0000	0.0000
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00
37. ANNUAL KWH COST	3108.80	3108.80	0.00
37D. DIESEL FUEL COST	276.58	62.18	214.40
38. GROUP RELAMPING PERIOD (HOURS)		9500.	1600.
38A. RATED LAMP LIFE (HOURS)		15000.	2000.
38B. PORTION OF LAMPS SPOT REPLACED		.20	.20
39. QUANTITY OF REPLACEMENT LAMPS		68.	2.
40. REPLACEMENT LAMP COST	2600.94	2572.80	28.14
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
43. GROUP RELAMPINGS/YEAR/LUMINAIRE		.42	.01
43A. SPOT RELAMPINGS/YEAR/LUMINAIRE		.0842	.0025
44. RELAMPING COST - LABOR	232.38	225.68	6.70
46. CLEANINGS/YEAR/LUMINAIRE		.58	.99
47. CLEANING COST - LABOR	419.81	155.16	264.65
48. PAINTING TIME PER POLE		0.00	0.00
50. PAINTING COST - LABOR	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	1095.18	512.28	582.90
52. TOTAL ANNUAL MAINTENANCE COST	1747.37	893.12	854.25
53. ANNUAL OPERATING COST	7733.69	6636.90	1096.79
54. ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.96	.83	.14
VI. ANNUAL OWNERSHIP + OPERATING COST			
55. FIXED OWNERSHIP COST	23767.87	10828.83	12939.04
56. ANNUAL OWNERSHIP + OP"ING COST	31501.56	17465.73	14035.83
58. TOTAL PER LINEAL FOOT ~~OR ACRE~~	3.92	2.17	1.75

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 21 — HIGH PRESSURE SODIUM W/O UPS PLUS 50 PERCENT QUARTZ BACKUP

	TOTAL FOR SYSTEM	2X250W HPS 120 FT SP	3X500W Q 120 FT SP
I. INITIAL EQUIPMENT INVESTMENT			
1. QUANTITY OF LUMINAIRES	335	134	201
2. LUMINAIRE COST EACH		240.00	42.00
3. LUMINAIRE COST TOTAL	40602.00	32160.00	8442.00
4. QUANTITY OF POLES	67	67	0
5. MOUNTING HEIGHT		15.00	15.00
6. POLE + BRACKET COST EACH		70.00	0.00
7. POLE COST TOTAL		4690.00	0.00
8. FOUNDATION COST EACH		0.00	0.00
9. POLE + FOUNDATION COST TOTAL	4690.00	4690.00	0.00
10. QTY LAMPS PER LUMINAIRE		1	1
11. QUANTITY LAMPS		134	201
12. LAMP COST EACH		38.00	13.00
13. LAMP COST TOTAL	7705.00	5092.00	2613.00
14. ELECTRICAL DISTRIBUTION	27872.00	7772.00	20100.00
14A. STANDBY GENERATOR COST	23691.20	6606.20	17085.00
14C. UPS COST	0.00	0.00	0.00
15. TOTAL INIT EQUIP LESS LAMPS		51228.20	45627.00
16. TOTAL INIT EQUIP INCL LAMPS	104560.20	56320.20	48240.00
II. INITIAL LABOR ESTIMATES			
18. POLE ERECTION + PAINTING		155.00	0.00
19. LUMINAIRE LABOR		60.00	60.00
20. NET LABOR, POLES + LUMINAIRES	30485.00	18425.00	12060.00
21. LABOR ELECTRICAL DISTRIBUTION	20904.00	5829.00	15075.00
21A. LABOR STANDBY GENERATOR	2787.20	777.20	2010.00
21B. LABOR UPS	0.00	0.00	0.00
22. TOTAL INITIAL LABOR	54176.20	25031.20	29145.00
23. TOTAL INITIAL INVESTMENT	158736.40	81351.40	77385.00
III. ILLUMINATION CALCULATIONS			
25. SPACING OR AREA		120.00	120.00
26. UTILIZATION FACTOR		0.00	0.00
27. MAINTENANCE FACTOR		.72	.81
28. DESIGN FOOTCANDLES		2.00	2.00
29. INIT COST PER LINEAL FT ~~OR AREA~~	19.74	10.12	9.63

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 21 — HIGH PRESSURE SODIUM W/O UPS PLUS 50 PERCENT QUARTZ BACKUP

	TOTAL FOR SYSTEM	2X250W HPS 120 FT SP	3X500W Q 120 FT SP
IV. ANNUAL COSTS			
30. KW PER LUMINAIRE		.29	.50
30A. KW UPS POWER LOSS		0.00	0.00
31. TOTAL SYSTEM KW	139.	39.	101.
32. ANNUAL OPERATION (HOURS)		4000.	20.
33. TOTAL ENERGY KWH/YEAR	157450.	155440.	2010.
34. ENERGY COST PER KWH		.0200	.0200
35. DEMAND CHARGE/KW/MONTH		0.0000	0.0000
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00
37. ANNUAL KWH COST	3149.00	3108.80	40.20
37D. DIESEL FUEL COST	222.98	62.18	160.80
38. GROUP RELAMPING PERIOD (HOURS)		9500.	1600.
38A. RATED LAMP LIFE (HOURS)		15000.	2000.
38B. PORTION OF LAMPS SPOT REPLACED		.20	.20
39. QUANTITY OF REPLACEMENT LAMPS		68.	3.
40. REPLACEMENT LAMP COST	2612.00	2572.80	39.20
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
43. GROUP RELAMPINGS/YEAR/LUMINAIRE		.42	.01
43A. SPOT RELAMPINGS/YEAR/LUMINAIRE		.0842	.0025
44. RELAMPING COST - LABOR	235.73	225.68	10.05
46. CLEANINGS/YEAR/LUMINAIRE		.58	.99
47. CLEANING COST - LABOR	552.13	155.16	396.98
48. PAINTING TIME PER POLE		0.00	0.00
50. PAINTING COST - LABOR	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	968.55	512.28	456.27
52. TOTAL ANNUAL MAINTENANCE COST	1756.42	893.12	863.29
53. ANNUAL OPERATING COST	7740.39	6636.90	1103.49
54. ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.96	.83	.14
VI. ANNUAL OWNERSHIP + OPERATING COST			
55. FIXED OWNERSHIP COST	21446.46	10828.83	10617.62
56. ANNUAL OWNERSHIP + OP"ING COST	29186.85	17465.73	11721.11
58. TOTAL PER LINEAL FOOT ~~OR ACRE~~	3.63	2.17	1.46

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRIC

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 22 — LOW PRESSURE SODIUM WITHOUT UPS OR QUARTZ BACKUP

		TOTAL FOR SYSTEM	2X90W LPS 100 FT SP
I.	**INITIAL EQUIPMENT INVESTMENT**		
1.	QUANTITY OF LUMINAIRES	160	160
2.	LUMINAIRE COST EACH		273.00
3.	LUMINAIRE COST TOTAL	43680.00	43680.00
4.	QUANTITY OF POLES	80	80
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		5600.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	5600.00	5600.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		160
12.	LAMP COST EACH		18.00
13.	LAMP COST TOTAL	2880.00	2880.00
14.	ELECTRICAL DISTRIBUTION	4480.00	4480.00
14A.	STANDBY GENERATOR COST	3808.00	3808.00
14C.	UPS COST	0.00	0.00
15.	TOTAL INIT EQUIP LESS LAMPS		57568.00
16.	TOTAL INIT EQUIP INCL LAMPS	60448.00	60448.00
II.	**INITIAL LABOR ESTIMATES**		
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		30.00
20.	NET LABOR, POLES + LUMINAIRES	17200.00	17200.00
21.	LABOR ELECTRICAL DISTRIBUTION	3360.00	3360.00
21A.	LABOR STANDBY GENERATOR	448.00	448.00
21B.	LABOR UPS	0.00	0.00
22.	TOTAL INITIAL LABOR	21008.00	21008.00
23.	TOTAL INITIAL INVESTMENT	158841.00	81456.00
III.	**ILLUMINATION CALCULATIONS**		
25.	SPACING OR AREA		100.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.85
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	10.18	10.18

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRI

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 22 — LOW PRESSURE SODIUM WITHOUT UPS OR QUARTZ BACKUP

		TOTAL FOR SYSTEM	2X90W LPS 100 FT SP
IV.	ANNUAL COSTS		
30.	KW PER LUMINAIRE		.14
30A.	KW UPS POWER LOSS		0.00
31.	TOTAL SYSTEM KW	22.	22.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	89600.	89600.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	1792.00	1792.00
37D.	DIESEL FUEL COST	35.84	35.84
38.	GROUP RELAMPING PERIOD (HOURS)		15000.
38A.	RATED LAMP LIFE (HOURS)		18000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		51.
40.	REPLACEMENT LAMP COST	921.60	921.60
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533
44.	RELAMPING COST - LABOR	170.67	170.67
46.	CLEANINGS/YEAR/LUMINAIRE		.73
47.	CLEANING COST - LABOR	234.67	234.67
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	575.68	575.68
52.	TOTAL ANNUAL MAINTENANCE COST	981.01	981.01
53.	ANNUAL OPERATING COST	3730.45	3730.45
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.47	.47
VI.	ANNUAL OWNERSHIP + OPERATING COST		
55.	FIXED OWNERSHIP COST	11157.79	11157.79
56.	ANNUAL OWNERSHIP + OP"ING COST	14888.25	14888.25
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	1.86	1.86

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER	LOW PRESSURE SODIUM
LIGHTING	WITH 100 PERCENT QUARTZ BACKUP
SCHEME 23	NO UPS

		TOTAL FOR SYSTEM	2X90W LPS 100 FT SP	2X1500W Q 100 FT SP
I.	INITIAL EQUIPMENT INVESTMENT			
1.	QUANTITY OF LUMINAIRES	320	160	160
2.	LUMINAIRE COST EACH		273.00	65.00
3.	LUMINAIRE COST TOTAL	54080.00	43680.00	10400.00
4.	QUANTITY OF POLES	80	80	0
5.	MOUNTING HEIGHT		15.00	15.00
6.	POLE + BRACKET COST EACH		70.00	0.00
7.	POLE COST TOTAL		5600.00	0.00
8.	FOUNDATION COST EACH		0.00	0.00
9.	POLE + FOUNDATION COST TOTAL	5600.00	5600.00	0.00
10.	QTY LAMPS PER LUMINAIRE		1	1
11.	QUANTITY LAMPS		160	160
12.	LAMP COST EACH		18.00	15.00
13.	LAMP COST TOTAL	5280.00	2880.00	2400.00
14.	ELECTRICAL DISTRIBUTION	52480.00	4480.00	48000.00
14A.	STANDBY GENERATOR COST	44608.00	3808.00	40800.00
14C.	UPS COST	0.00	0.00	0.00
15.	TOTAL INIT EQUIP LESS LAMPS		57568.00	99200.00
16.	TOTAL INIT EQUIP INCL LAMPS	162048.00	60448.00	101600.00
II.	INITIAL LABOR ESTIMATES			
18.	POLE ERECTION + PAINTING		155.00	0.00
19.	LUMINAIRE LABOR		30.00	75.00
20.	NET LABOR, POLES + LUMINAIRES	[illegible]	17200.00	12000.00
21.	LABOR ELECTRICAL DISTRIBUTION	39360.00	3360.00	36000.00
21A.	LABOR STANDBY GENERATOR	5248.00	448.00	4800.00
21B.	LABOR UPS	0.00	0.00	0.00
22.	TOTAL INITIAL LABOR	73808.00	21608.00	52800.00
23.	TOTAL INITIAL INVESTMENT	235856.00	81456.00	154400.00
III.	ILLUMINATION CALCULATIONS			
25.	SPACING OR AREA		100.00	100.00
26.	UTILIZATION FACTOR		0.00	0.00
27.	MAINTENANCE FACTOR		.85	.81
28.	DESIGN FOOTCANDLES		2.00	2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	29.48	10.18	19.30

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 23 — LOW PRESSURE SODIUM WITH 100 PERCENT QUARTZ BACKUP NO UPS

		TOTAL FOR SYSTEM	2X90W LPS 100 FT SP	2X1500W Q 100 FT SP
IV.	ANNUAL COSTS			
30.	KW PER LUMINAIRE		.14	1.50
30A.	KW UPS POWER LOSS		0.00	0.00
31.	TOTAL SYSTEM KW	262.	22.	240.
32.	ANNUAL OPERATION (HOURS)		4000.	20.
33.	TOTAL ENERGY KWH/YEAR	94400.	89600.	4800.
34.	ENERGY COST PER KWH		.0200	.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000	0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00	0.00
37.	ANNUAL KWH COST	1888.00	1792.00	96.00
37D.	DIESEL FUEL COST	419.84	35.84	384.00
38.	GROUP RELAMPING PERIOD (HOURS)		15000.	1600.
38A.	RATED LAMP LIFE (HOURS)		18000.	2000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20	.20
39.	QUANTITY OF REPLACEMENT LAMPS		51.	2.
40.	REPLACEMENT LAMP COST	957.60	921.60	36.00
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS			
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27	.01
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533	.0025
44.	RELAMPING COST - LABOR	178.67	170.67	8.00
46.	CLEANINGS/YEAR/LUMINAIRE		.73	.99
47.	CLEANING COST - LABOR	550.67	234.67	316.00
48.	PAINTING TIME PER POLE		0.00	0.00
50.	PAINTING COST - LABOR	0.00	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	1567.68	575.68	992.00
52.	TOTAL ANNUAL MAINTENANCE COST	2297.01	981.01	1316.00
53.	ANNUAL OPERATING COST	5562.45	3730.45	1832.00
54.	ANNUAL OP'NG COST PER FT ~~OR ACRE~~	.70	.47	.23
VI.	ANNUAL OWNERSHIP + OPERATING COST			
55.	FIXED OWNERSHIP COST	32741.79	11157.79	21584.00
56.	ANNUAL OWNERSHIP + OP'NG COST	38304.25	14888.25	23416.00
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	4.79	1.86	2.93

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER	LOW PRESSURE SODIUM
LIGHTING	WITH 75 PERCENT QUARTZ BACKUP
SCHEME 24	NO UPS

	TOTAL FOR SYSTEM	2X90W LPS 100 FT SP	2X1000 W Q 100 FT SP
I. INITIAL EQUIPMENT INVESTMENT			
1. QUANTITY OF LUMINAIRES	320	160	160
2. LUMINAIRE COST EACH		273.00	65.00
3. LUMINAIRE COST TOTAL	54080.00	43680.00	10400.00
4. QUANTITY OF POLES	80	80	0
5. MOUNTING HEIGHT		15.00	15.00
6. POLE + BRACKET COST EACH		70.00	0.00
7. POLE COST TOTAL		5600.00	0.00
8. FOUNDATION COST EACH		0.00	0.00
9. POLE + FOUNDATION COST TOTAL	5600.00	5600.00	0.00
10. QTY LAMPS PER LUMINAIRE		1	1
11. QUANTITY LAMPS		160	160
12. LAMP COST EACH		18.00	14.00
13. LAMP COST TOTAL	5120.00	2880.00	2240.00
14. ELECTRICAL DISTRIBUTION	36480.00	4480.00	32000.00
14A. STANDBY GENERATOR COST	31008.00	3808.00	27200.00
14C. UPS COST	0.00	0.00	0.00
15. TOTAL INIT EQUIP LESS LAMPS		57568.00	69600.00
16. TOTAL INIT EQUIP INCL LAMPS	132288.00	60448.00	71840.00
II. INITIAL LABOR ESTIMATES			
18. POLE ERECTION + PAINTING		155.00	0.00
19. LUMINAIRE LABOR		30.00	75.00
20. NET LABOR, POLES + LUMINAIRES	29200.00	17200.00	12000.00
21. LABOR ELECTRICAL DISTRIBUTION	27360.00	3360.00	24000.00
21A. LABOR STANDBY GENERATOR	3648.00	448.00	3200.00
21B. LABOR UPS	0.00	0.00	0.00
22. TOTAL INITIAL LABOR	60208.00	21008.00	39200.00
23. TOTAL INITIAL INVESTMENT	192496.00	81456.00	111040.00
III. ILLUMINATION CALCULATIONS			
25. SPACING OR AREA		100.00	100.00
26. UTILIZATION FACTOR		0.00	0.00
27. MAINTENANCE FACTOR		.85	.81
28. DESIGN FOOTCANDLES		2.00	2.00
29. INIT COST PER LINEAL FT ~~OR ACRE~~	24.06	10.18	13.88

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 24 — LOW PRESSURE SODIUM WITH 75 PERCENT QUARTZ BACKUP NO UPS

		TOTAL FOR SYSTEM	2X90W LPS 100 FT SP	2X1000 W Q 100 FT SP
IV.	ANNUAL COSTS			
30.	KW PER LUMINAIRE		.14	1.00
30A.	KW UPS POWER LOSS		0.00	0.00
31.	TOTAL SYSTEM KW	182.	22.	160.
32.	ANNUAL OPERATION (HOURS)		4000.	20.
33.	TOTAL ENERGY KWH/YEAR	92800.	89600.	3200.
34.	ENERGY COST PER KWH		.0200	.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000	0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00	0.00
37.	ANNUAL KWH COST	1856.00	1792.00	64.00
37D.	DIESEL FUEL COST	291.84	35.84	256.00
38.	GROUP RELAMPING PERIOD (HOURS)		15000.	1600.
38A.	RATED LAMP LIFE (HOURS)		18000.	2000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20	.20
39.	QUANTITY OF REPLACEMENT LAMPS		51.	2.
40.	REPLACEMENT LAMP COST	955.20	921.60	33.60
V.	ANNUAL MAINTENANCE, LABOR + MATERIALS			
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.27	.01
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533	.0025
44.	RELAMPING COST - LABOR	178.67	170.67	8.00
46.	CLEANINGS/YEAR/LUMINAIRE		.73	.99
47.	CLEANING COST - LABOR	550.67	234.67	316.00
48.	PAINTING TIME PER POLE		0.00	0.00
50.	PAINTING COST - LABOR	0.00	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	1271.68	575.68	696.00
52.	TOTAL ANNUAL MAINTENANCE COST	2001.01	981.01	1020.00
53.	ANNUAL OPERATING COST	5104.05	3730.45	1373.60
54.	ANNUAL OP"NG COST PER FT ~~OR ACRE~~	.64	.47	.17
VI.	ANNUAL OWNERSHIP + OPERATING COST			
55.	FIXED OWNERSHIP COST	26607.39	11157.79	15449.60
56.	ANNUAL OWNERSHIP + OP"ING COST	31711.45	14888.25	16823.20
58.	TOTAL PER LINEAL FOOT ~~OR ACRE~~	3.96	1.86	2.10

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 25 — LOW PRESSURE SODIUM WITH 50 PERCENT QUARTZ BACKUP NO UPS

	TOTAL FOR SYSTEM	2X90W LPS 100 FT SP	3X500W Q 100 FT SP
I. INITIAL EQUIPMENT INVESTMENT			
1. QUANTITY OF LUMINAIRES	400	160	240
2. LUMINAIRE COST EACH		273.00	42.00
3. LUMINAIRE COST TOTAL	53760.00	43680.00	10080.00
4. QUANTITY OF POLES	80	80	0
5. MOUNTING HEIGHT		15.00	15.00
6. POLE + BRACKET COST EACH		70.00	0.00
7. POLE COST TOTAL		5600.00	0.00
8. FOUNDATION COST EACH		0.00	0.00
9. POLE + FOUNDATION COST TOTAL	5600.00	5600.00	0.00
10. QTY LAMPS PER LUMINAIRE		1	1
11. QUANTITY LAMPS		160	240
12. LAMP COST EACH		18.00	13.00
13. LAMP COST TOTAL	6000.00	2880.00	3120.00
14. ELECTRICAL DISTRIBUTION	28480.00	4480.00	24000.00
14A. STANDBY GENERATOR COST	24208.00	3808.00	20400.00
14C. UPS COST	0.00	0.00	0.00
15. TOTAL INIT EQUIP LESS LAMPS		57568.00	54480.00
16. TOTAL INIT EQUIP INCL LAMPS	118048.00	60448.00	57600.00
II. INITIAL LABOR ESTIMATES			
18. POLE ERECTION + PAINTING		155.00	0.00
19. LUMINAIRE LABOR		30.00	60.00
20. NET LABOR, POLES + LUMINAIRES	31600.00	17200.00	14400.00
21. LABOR ELECTRICAL DISTRIBUTION	21360.00	3360.00	18000.00
21A. LABOR STANDBY GENERATOR	2848.00	448.00	2400.00
21B. LABOR UPS	0.00	0.00	0.00
22. TOTAL INITIAL LABOR	55808.00	21008.00	34800.00
23. TOTAL INITIAL INVESTMENT	173856.00	81456.00	92400.00
III. ILLUMINATION CALCULATIONS			
25. SPACING OR AREA		100.00	100.00
26. UTILIZATION FACTOR		0.00	0.00
27. MAINTENANCE FACTOR		.85	.81
28. DESIGN FOOTCANDLES		2.00	2.00
29. INIT COST PER LINEAL FT ~~OR AREA~~	21.73	10.18	11.55

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 25 — LOW PRESSURE SODIUM WITH 50 PERCENT QUARTZ BACKUP NO UPS

	TOTAL FOR SYSTEM	2X90W LPS 100 FT SP	3X500W Q 100 FT SP
IV. ANNUAL COSTS			
30. KW PER LUMINAIRE		.14	.50
30A. KW UPS POWER LOSS		0.00	0.00
31. TOTAL SYSTEM KW	142.	22.	120.
32. ANNUAL OPERATION (HOURS)		4000.	20.
33. TOTAL ENERGY KWH/YEAR	92000.	89600.	2400.
34. ENERGY COST PER KWH		.0200	.0200
35. DEMAND CHARGE/KW/MONTH		0.0000	0.0000
36. DEMAND CHARGE PER YEAR	0.00	0.00	0.00
37. ANNUAL KWH COST	1840.00	1792.00	48.00
37D. DIESEL FUEL COST	227.84	35.84	192.00
38. GROUP RELAMPING PERIOD (HOURS)		15000.	1600.
38A. RATED LAMP LIFE (HOURS)		18000.	2000.
38B. PORTION OF LAMPS SPOT REPLACED		.20	.20
39. QUANTITY OF REPLACEMENT LAMPS		51.	4.
40. REPLACEMENT LAMP COST	968.40	921.60	46.80
V. ANNUAL MAINTENANCE, LABOR + MATERIALS			
43. GROUP RELAMPINGS/YEAR/LUMINAIRE		.27	.01
43A. SPOT RELAMPINGS/YEAR/LUMINAIRE		.0533	.0025
44. RELAMPING COST - LABOR	182.67	170.67	12.00
46. CLEANINGS/YEAR/LUMINAIRE		.73	.99
47. CLEANING COST - LABOR	708.67	234.67	474.00
48. PAINTING TIME PER POLE		0.00	0.00
50. PAINTING COST - LABOR	0.00	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	1120.48	575.68	544.80
52. TOTAL ANNUAL MAINTENANCE COST	2011.81	981.01	1030.80
53. ANNUAL OPERATING COST	5048.05	3730.45	1317.60
54. ANNUAL OP"NG COST PER FT OR ACRE	.63	.47	.16
VI. ANNUAL OWNERSHIP + OPERATING COST			
55. FIXED OWNERSHIP COST	23835.55	11157.79	12677.76
56. ANNUAL OWNERSHIP + OP"NG COST	28883.61	14888.25	13995.36
58. TOTAL PER LINEAL FOOT ~~OR ACRE~~	3.61	1.86	1.75

U.S. ARMY CORPS OF ENGINEERS, OMAHA DIST[illegible]

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 26 — DOUBLE FENCE QUARTZ LIGHTING TEST 55A

	TOTAL FOR SYSTEM	1X1500W Q 15 FT MTG 50 FT SP
I. INITIAL EQUIPMENT INVESTMENT		
1. QUANTITY OF LUMINAIRES	160	160
2. LUMINAIRE COST EACH		65.00
3. LUMINAIRE COST TOTAL	10400.00	10400.00
4. QUANTITY OF POLES	160	160
5. MOUNTING HEIGHT		15.00
6. POLE + BRACKET COST EACH		70.00
7. POLE COST TOTAL		11200.00
8. FOUNDATION COST EACH		0.00
9. POLE + FOUNDATION COST TOTAL	11200.00	11200.00
10. QTY LAMPS PER LUMINAIRE		1
11. QUANTITY LAMPS		160
12. LAMP COST EACH		15.00
13. LAMP COST TOTAL	2400.00	2400.00
14. ELECTRICAL DISTRIBUTION	48000.00	48000.[illegible]
14A. STANDBY GENERATOR COST	40800.00	40800.[illegible]
14C. UPS COST	0.00	0.00
15. TOTAL INIT EQUIP LESS LAMPS		110400.00
16. TOTAL INIT EQUIP INCL LAMPS	112800.00	112800.00
II. INITIAL LABOR ESTIMATES		
18. POLE ERECTION + PAINTING		155.00
19. LUMINAIRE LABOR		75.00
20. NET LABOR, POLES + LUMINAIRES	36800.00	36800.00
21. LABOR ELECTRICAL DISTRIBUTION	36000.00	36000.00
21A. LABOR STANDBY GENERATOR	4800.00	4800.00
21B. LABOR UPS	0.00	0.00
22. TOTAL INITIAL LABOR	77600.00	77600.00
23. TOTAL INITIAL INVESTMENT	190400.00	190400.00
III. ILLUMINATION CALCULATIONS		
25. SPACING OR AREA		50.00
26. UTILIZATION FACTOR		0.00
27. MAINTENANCE FACTOR		.81
28. DESIGN FOOTCANDLES		2.00
29. INIT COST PER LINEAL FT ~~OR ACRE~~	23.80	23.80

PERIMETER LIGHTING SCHEME 26 — DOUBLE FENCE QUARTZ LIGHTING TEST 55A

	TOTAL FOR SYSTEM	1X1500W Q 15 FT MTG 50 FT SP
IV. ANNUAL COSTS		
30. KW PER LUMINAIRE		1.50
30A. KW UPS POWER LOSS		0.00
31. TOTAL SYSTEM KW	240.	240.
32. ANNUAL OPERATION (HOURS)		4000.
33. TOTAL ENERGY KWH/YEAR	960000.	960000.
34. ENERGY COST PER KWH		.0200
35. DEMAND CHARGE/KW/MONTH		0.0000
36. DEMAND CHARGE PER YEAR	0.00	0.00
37. ANNUAL KWH COST	19200.00	19200.00
37D. DIESEL FUEL COST	384.00	384.00
38. GROUP RELAMPING PERIOD (HOURS)		1600.
38A. RATED LAMP LIFE (HOURS)		2000.
38B. PORTION OF LAMPS SPOT REPLACED		.20
39. QUANTITY OF REPLACEMENT LAMPS		480.
40. REPLACEMENT LAMP COST	7200.00	7200.00
V. ANNUAL MAINTENANCE, LABOR + MATERIALS		
43. GROUP RELAMPINGS/YEAR/LUMINAIRE		2.50
43A. SPOT RELAMPINGS/YEAR/LUMINAIRE		.5000
44. RELAMPING COST - LABOR	1600.00	1600.00
46. CLEANINGS/YEAR/LUMINAIRE		0.00
47. CLEANING COST - LABOR	0.00	0.00
48. PAINTING TIME PER POLE		0.00
50. PAINTING COST - LABOR	0.00	0.00
51. REPLACEMENT PARTS, PAINT, ETC.	1104.00	1104.00
52. TOTAL ANNUAL MAINTENANCE COST	2704.00	2704.00
53. ANNUAL OPERATING COST	29488.00	29488.00
54. ANNUAL OP'NG COST PER FT ~~OR ACRE~~	3.69	3.69
VI. ANNUAL OWNERSHIP + OPERATING COST		
55. FIXED OWNERSHIP COST	26696.00	26696.00
56. ANNUAL OWNERSHIP + OP'ING COST	56184.00	56184.00
58. TOTAL PER LINEAL FOOT ~~OR ACRE~~	7.02	7.02

PERIMETER LIGHTING SCHEME 27 — DOUBLE FENCE HIGH PRESSURE SODIUM TEST 96B WITH UPS

	TOTAL FOR SYSTEM	1X400W HPS 15 FT MTG 80 FT SP
I. INITIAL EQUIPMENT INVESTMENT		
1. QUANTITY OF LUMINAIRES	100	100
2. LUMINAIRE COST EACH		250.00
3. LUMINAIRE COST TOTAL	25000.00	25000.00
4. QUANTITY OF POLES	100	100
5. MOUNTING HEIGHT		15.00
6. POLE + BRACKET COST EACH		70.00
7. POLE COST TOTAL		7000.00
8. FOUNDATION COST EACH		0.00
9. POLE + FOUNDATION COST TOTAL	7000.00	7000.00
10. QTY LAMPS PER LUMINAIRE		1
11. QUANTITY LAMPS		100
12. LAMP COST EACH		39.00
13. LAMP COST TOTAL	3900.00	3900.00
14. ELECTRICAL DISTRIBUTION	11500.00	11500.00
14A. STANDBY GENERATOR COST	9775.00	9775.0
14C. UPS COST	34500.00	34500.00
15. TOTAL INIT EQUIP LESS LAMPS		87775.00
16. TOTAL INIT EQUIP INCL LAMPS	91675.00	91675.00
II. INITIAL LABOR ESTIMATES		
18. POLE ERECTION + PAINTING		155.00
19. LUMINAIRE LABOR		75.00
20. NET LABOR, POLES + LUMINAIRES	23000.00	23000.00
21. LABOR ELECTRICAL DISTRIBUTION	8625.00	8625.00
21A. LABOR STANDBY GENERATOR	1150.00	1150.00
21B. LABOR UPS	4600.00	4600.00
22. TOTAL INITIAL LABOR	37375.00	37375.00
23. TOTAL INITIAL INVESTMENT	129050.00	129050.00
III. ILLUMINATION CALCULATIONS		
25. SPACING OR AREA		80.00
26. UTILIZATION FACTOR		0.00
27. MAINTENANCE FACTOR		.72
28. DESIGN FOOTCANDLES		2.00
29. INIT COST PER LINEAL FT [redacted]	16.13	16.13

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 27 — DOUBLE FENCE HIGH PRESSURE SODIUM TEST 96B WITH UPS

		TOTAL FOR SYSTEM	1X400W HPS 15 FT MTG 80 FT SP
IV.	**ANNUAL COSTS**		
30.	KW PER LUMINAIRE		.46
30A.	KW UPS POWER LOSS		11.50
31.	TOTAL SYSTEM KW	58.	58.
32.	ANNUAL OPERATION (HOURS)		4000.
33.	TOTAL ENERGY KWH/YEAR	230000.	230000.
34.	ENERGY COST PER KWH		.0200
35.	DEMAND CHARGE/KW/MONTH		0.0000
36.	DEMAND CHARGE PER YEAR	0.00	0.00
37.	ANNUAL KWH COST	4600.00	4600.00
37D.	DIESEL FUEL COST	92.00	92.00
38.	GROUP RELAMPING PERIOD (HOURS)		13000.
38A.	RATED LAMP LIFE (HOURS)		20000.
38B.	PORTION OF LAMPS SPOT REPLACED		.20
39.	QUANTITY OF REPLACEMENT LAMPS		37.
40.	REPLACEMENT LAMP COST	1440.00	1440.00
V.	**ANNUAL MAINTENANCE, LABOR + MATERIALS**		
43.	GROUP RELAMPINGS/YEAR/LUMINAIRE		.31
43A.	SPOT RELAMPINGS/YEAR/LUMINAIRE		.0615
44.	RELAMPING COST - LABOR	123.08	123.08
46.	CLEANINGS/YEAR/LUMINAIRE		.69
47.	CLEANING COST - LABOR	138.46	138.46
48.	PAINTING TIME PER POLE		0.00
50.	PAINTING COST - LABOR	0.00	0.00
51.	REPLACEMENT PARTS, PAINT, ETC.	877.75	877.75
52.	TOTAL ANNUAL MAINTENANCE COST	1139.29	1139.29
53.	ANNUAL OPERATING COST	7271.29	7271.29
54.	ANNUAL OP'NG COST PER FT [redacted]	.91	.91
VI.	**ANNUAL OWNERSHIP + OPERATING COST**		
55.	FIXED OWNERSHIP COST	17771.30	17771.30
56.	ANNUAL OWNERSHIP + OP'ING COST	25042.59	25042.59
58.	TOTAL PER LINEAL FOOT [redacted]	3.13	3.13

U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT

ECONOMIC COMPARISION

PERIMETER LIGHTING SCHEME 28	DOUBLE FENCE LOW PRESSURE SODIUM TEST 80E WITH UPS

		TOTAL FOR SYSTEM	1X180W LPS 15 FT MTG 60 FT SP
I.	**INITIAL EQUIPMENT INVESTMENT**		
1.	QUANTITY OF LUMINAIRES	134	134
2.	LUMINAIRE COST EACH		360.00
3.	LUMINAIRE COST TOTAL	48240.00	48240.00
4.	QUANTITY OF POLES	134	134
5.	MOUNTING HEIGHT		15.00
6.	POLE + BRACKET COST EACH		70.00
7.	POLE COST TOTAL		9380.00
8.	FOUNDATION COST EACH		0.00
9.	POLE + FOUNDATION COST TOTAL	9380.00	9380.00
10.	QTY LAMPS PER LUMINAIRE		1
11.	QUANTITY LAMPS		134
12.	LAMP COST EACH		33.00
13.	LAMP COST TOTAL	4422.00	4422.00
14.	ELECTRICAL DISTRIBUTION	8040.00	8040.00
14A.	STANDBY GENERATOR COST	6834.00	6834.00
14C.	UPS COST	24120.00	24120.00
15.	TOTAL INIT EQUIP LESS LAMPS		96614.00
16.	TOTAL INIT EQUIP INCL LAMPS	101036.00	101036.00
II.	**INITIAL LABOR ESTIMATES**		
18.	POLE ERECTION + PAINTING		155.00
19.	LUMINAIRE LABOR		75.00
20.	NET LABOR, POLES + LUMINAIRES	30820.00	30820.00
21.	LABOR ELECTRICAL DISTRIBUTION	6030.00	6030.00
21A.	LABOR STANDBY GENERATOR	804.00	804.00
21B.	LABOR UPS	3216.00	3216.00
22.	TOTAL INITIAL LABOR	40870.00	40870.00
23.	TOTAL INITIAL INVESTMENT	141906.00	141906.00
III.	**ILLUMINATION CALCULATIONS**		
25.	SPACING OR AREA		60.00
26.	UTILIZATION FACTOR		0.00
27.	MAINTENANCE FACTOR		.85
28.	DESIGN FOOTCANDLES		2.00
29.	INIT COST PER LINEAL FT ~~OR ACRE~~	17.65	17.65